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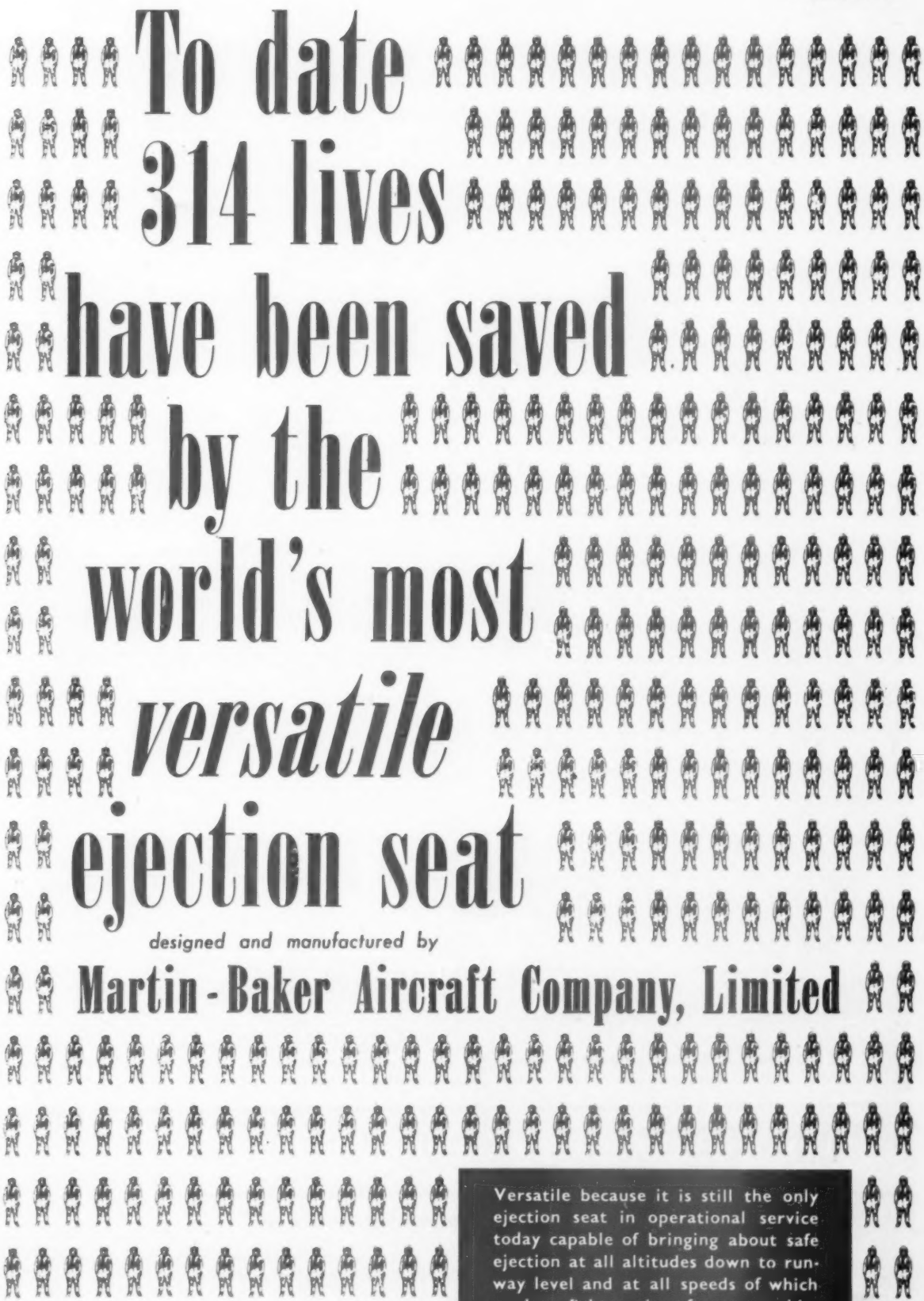

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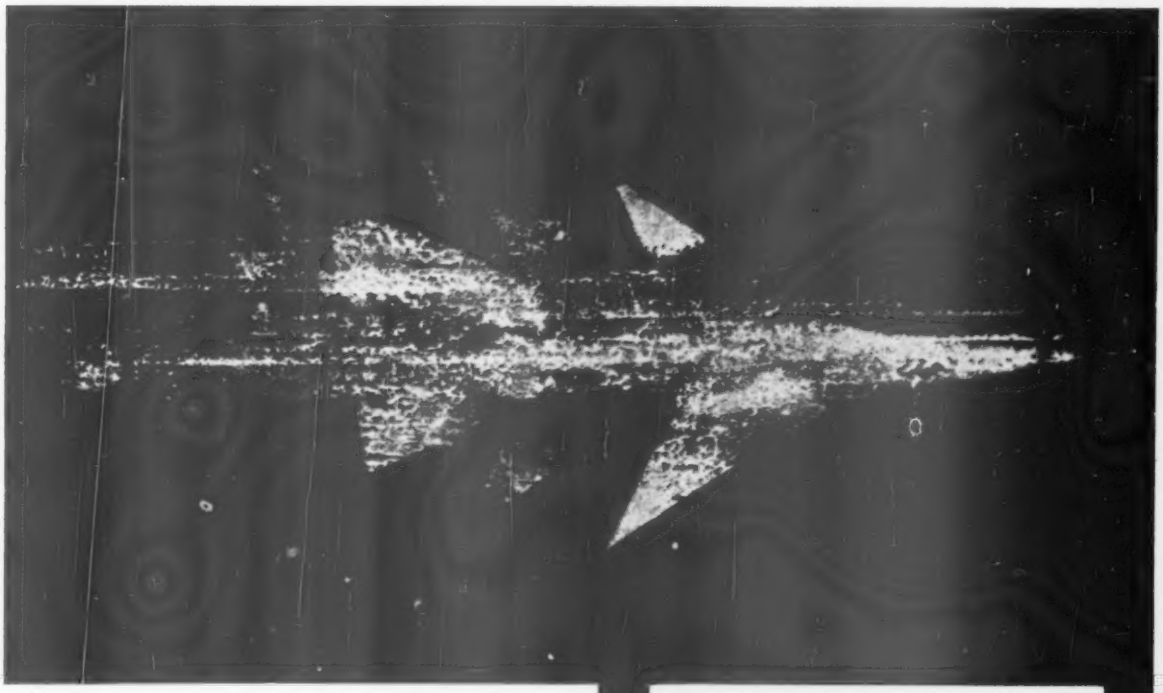

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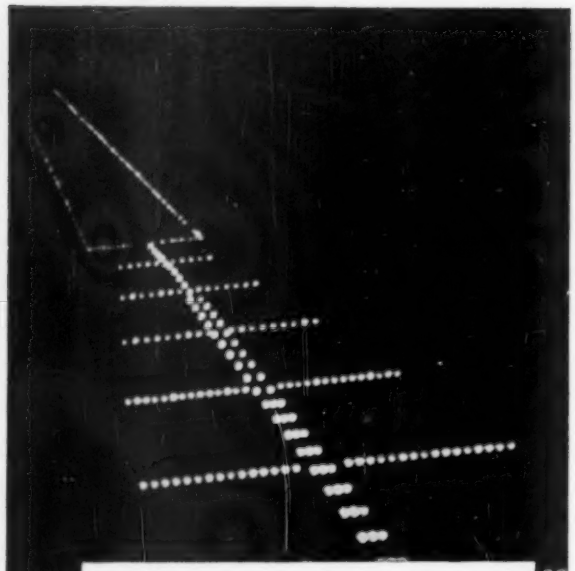

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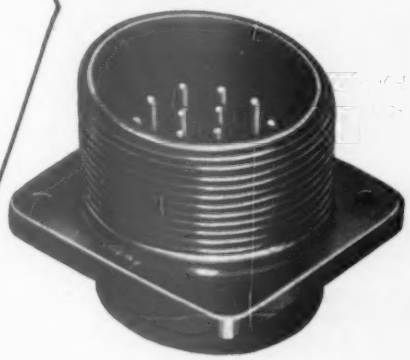

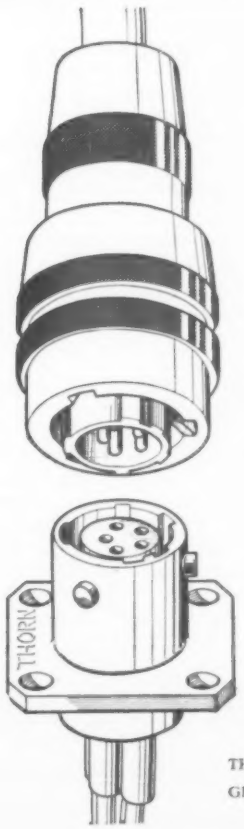

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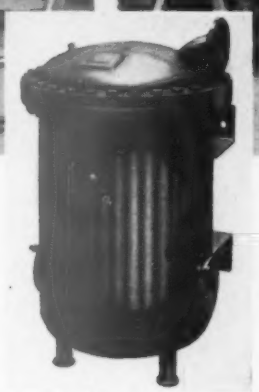

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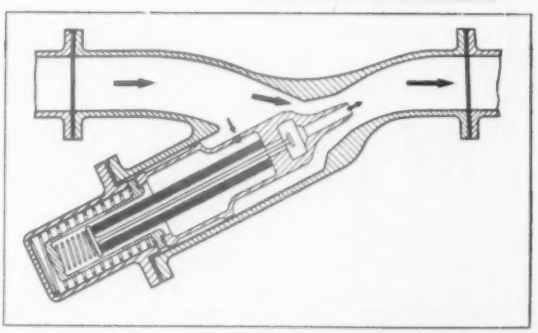
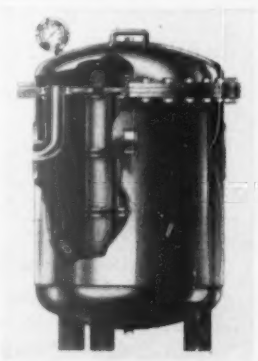
Middle right is the Fuel Monitor designed in conjunction with the Shell Petroleum Company Ltd. This is a fully "fail-safe" device consisting of a valve and a water sensitive element continuously sampling the flow of fuel and causing the main valve to close if water contaminated fuel is revealed.

Bottom right is the high-output MC filter, giving what is for many purposes an acceptable filtration efficiency at a much higher rate than the K type.





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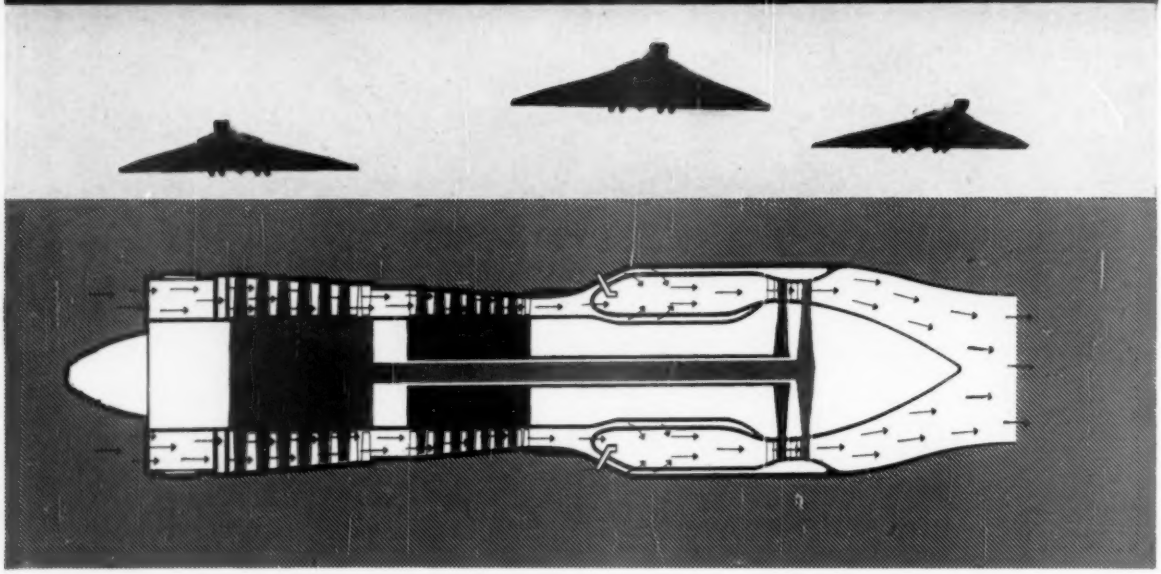

. . . ANOTHER ENGINEERING ADVANCE BY BRISTOL SIDDELEY

One of the largest manufacturers of motive power units in the world, Bristol Siddeley Engines Limited produce the Olympus. The Olympus is one of the most powerful and efficient high-thrust turbojets in service anywhere and therefore most performance details are security restricted. It can be said, however, that the Olympus possesses outstanding handling qualities. In a slam acceleration to full power from ground idling it considerably betters the official requirement. It also has one of the lowest specific fuel consumptions, and the highest thrust/weight ratio of any type-tested aero-engine in its class.

The Olympus owes its excellent all-round performance to the two-spool compressor system, pioneered by Bristol Siddeley and since adopted by the leading aero-engine producers in Britain and the USA. Proof of Olympus reliability is given by the fact that it already has the longest overhaul life of any British fighter or bomber powerplant. And the series has been proved to have enormous development potential. The first production version delivered 11,000-lb thrust dry, while the current engine reaches 17,000-lb thrust dry (24,000 lb with fully variable reheat). Even more advanced Olympus versions are rated at 33,000 lb with reheat.

Olympus applications

The Bristol Siddeley Olympus is ideally suited to operation at transonic and supersonic speeds. The Mark 201 gives the Avro Vulcan B 2 V-bomber an all-round performance unsurpassed by any other aircraft of its type. The Olympus has also been selected for the very advanced Vickers/English Electric TSR-2, the RAF's new tactical support/reconnaissance aircraft. Other Olympus versions are under active consideration for the next generation of civil airliners—the supersonic transports.

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THE AEROPLANE and ASTRONAUTICS

VOLUME 98 NUMBER 2516 JANUARY 8, 1960

A Great C.A.S.

All too soon the four strenuous years which Marshal of the Royal Air Force Sir Dermot Boyle has spent as Chief of the Air Staff have passed. Last week he retired from active service. It was good therefore to see the tribute paid to his work in *The Observer* of Sunday last.

Not least of Sir Dermot's achievements will be recognized in his unfaltering dissemination of the fact that in the Royal Air Force there will always be a place for the pilot. There can be no doubt that historians will recognize that the holding of exercise "Prospect" two years ago marked the point at which the pendulum reversed its swing. Today nobody believes that defence forces can be entirely replaced by automatons and robot weapons. The professional fighting man is still a must.

We wonder whether it ever crossed the mind of the first Chief of the Air Staff to graduate from Cranwell, when as a cadet he was considering the future, that it would fall to his lot to uphold the place of the pilot in the R.A.F.

Straws in the Wind

An unspectacular announcement by Trans-Canada Air Lines last week marked another stage in the development of the so-called "open-rate" situation following the failure of airlines to agree at the IATA traffic conferences in Honolulu. T.C.A. proposes (subject to government approval) to drop the turbojet surcharge when it starts transatlantic operations with DC-8s in June. Since this airline has a co-operative arrangement with B.O.A.C., it is to be supposed that the Corporation will also apply unsurcharged fares this year.

In November South African Airways announced its intention of applying economy fares on the Johannesburg-London service this autumn when its 707s go into service and, as recorded on p.33, Eagle Airways continues to apply pressure, in its own way, to obtain a decision on the very low fare applications, for services on cabotage routes, which this operator and Hunting-Clan put to the A.T.A.C. about a year ago.

The air-fares situation over the greater part of the World is likely to go through a period of minor confusion during the next few months while governments take over where IATA left off. But the open-rate situation—and the efforts of the British independents—must, in the end, produce a more rational attitude towards fare and freight-rate structures. The outcome will not only benefit the air traveller, actual and potential—but also the builders of freight aircraft.

Comets by the Score

A slow start is not necessarily a bad start. As the hours of operational experience build up so does the interest of the airlines in the Comet, the optimum-size jet transport. It was the flexibility of the Comet 4 which ranked high among the reasons for its selection by Misrair S.A.E. Across the South Atlantic the Comets of Aerolineas, and soon of B.O.A.C., are bringing a new standard of speed and comfort to Latin-American air travel. Unlike the giant jets, the Comets do not have to wait for existing airfields to be extended.

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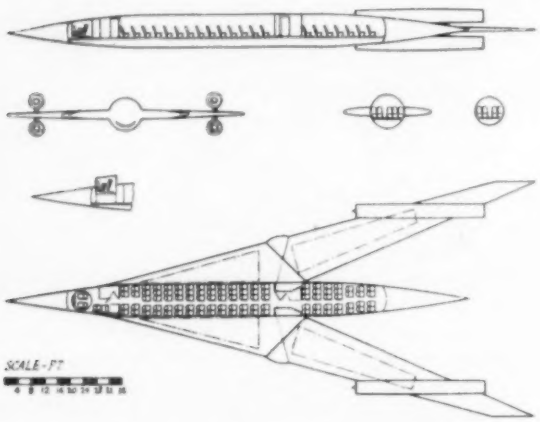
Matters of Moment

Variable-geometry Developments

ALTHOUGH details of the Wallis Swallow variable-geometry aircraft project are still shrouded in a good deal of secrecy, a little more information on this remarkable design was given last week by Dr. Barnes Wallis himself. However, most of what he had to say about the underlying principles of the project confirmed our speculations 18 months ago when first news of the Swallow was made known (THE AEROPLANE for May 16, 1958).

Among the things that came to light last week was that Dr. Barnes Wallis is proceeding with a design study for a naval variable-geometry aeroplane of the Swallow type. This presumably represents the military possibility on which any subsequent civil development would depend. For naval use, such an aircraft would happily combine the slow landing speeds that are so necessary for carrier operation and patrol flying with the supersonic speeds required for more active rôles. Bristol Siddeley Orpheus turbojets have been mentioned as possible powerplants.

Dr. Wallis disclosed that the final Swallow variable-geometry



A possible layout for a civil version of the Wallis Swallow variable-geometry aircraft project, discussed by Dr. Barnes Wallis last week.

configuration arose out of some experiments done about nine years ago with a radio-controlled model called the Wild Goose. This had an orthodox fuselage but a large-span unswept wing at the rear that could be swivelled for trim. The model was launched from an HTP rocket-propelled trolley. Wing-tip fins were provided for directional control and small elevons were incorporated at the trailing edge for pitch and roll control. The experiments with Wild Goose successfully proved the practicability of the rear wing layout at low speeds.

For high-speed flight, the ideal shape was considered to be a very narrow delta; and as the centre part of the trailing-edge portion contributed nothing to the lift but added considerably to the skin drag, the characteristic "swallow" or "arrow-head" shape was evolved. With the very highly swept arrow-head planform, however, there is one basic problem—in the landing and take-off attitude to keep the wing-tips clear of the ground the undercarriage would need to be impracticably stalky.

From these considerations it was a logical step to the variable-geometry proposal with the wing swung forward to an unswept position for low-speed operation and moved back to form the highly swept "cut-away delta" for high-speed flight.

To maintain trim with the wing moved back it was found necessary to make some corresponding weight shift. This can be achieved by mounting the powerplants on the outboard part of the wing and it is possible to so arrange matters that the C.G. remains in the correct position in relation to the wing's centre of pressure. This is made possible because the C.P. in the straight-wing configuration is much farther forward than it is when the wing is moved to its rearward position.

Mounting the powerplants on the moving part of the wing meant that they had to be pivoted so as to remain in the line of flight. And having had to provide this degree of freedom in one direction, it was logical to allow the powerplants to be pivoted in the vertical plane as well.

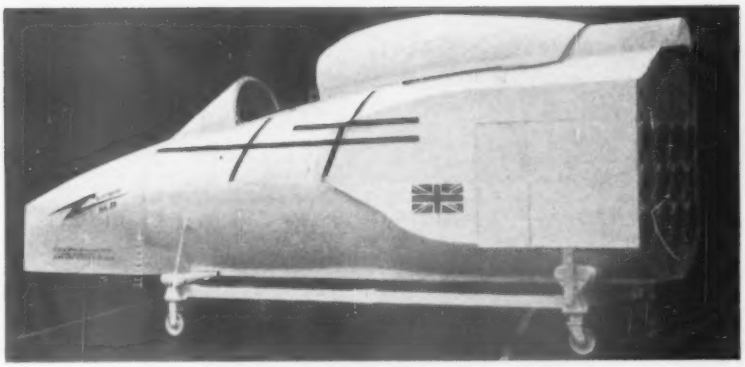
Thus all control of the Swallow is provided by powerplant movement. Tilting them up causes the aircraft to dive and vice versa; with one powerplant pair tilted up and the other down, the aircraft will roll; and with both swung sideways the aircraft will turn in the opposite direction.

No details of the size and performance of a likely full-scale Swallow were given by Dr. Wallis. He mentioned, however, a weight of 100,000 lb. for a 60-passenger civil transport having a wing loading of the order of 40 lb./sq. ft. and a take-off run of about 200-300 yards. In the supersonic configuration, with wings back, the overall length would be about 130 ft.; and with them spread, the span would be about 130 ft.

It seems strange that the occasion chosen for these first public revelations of the remarkable Swallow project was a Christmas lecture for young people at the Institution of Civil Engineers. Evidently Dr. Wallis felt that the youngsters would show more enthusiasm than many of their elders in official places for what, after all, has been the most stimulating aeronautical proposal in recent years.

TAKING OVER.—Air Chief Marshal Sir Thomas Pike takes up his appointment as Chief of the Air Staff this month. He succeeds Marshal of the Royal Air Force, Sir Dermot Boyle, who has been C.A.S. since January, 1956.

HONOURED.—Among those honoured by Her Majesty the Queen in the New Year Honours list (see page 32) were, left to right: Sir George Nelson (Baron); Prof. H. S. W. Massey (Knighthood); Air Chief Marshal Sir Harry Broadhurst (G.C.B.); L. J. Dunnett (K.C.B.); and Rear Admiral Sir Matthew Slattery (K.B.E.)



NA.39 ESCAPE.—"Through-the-canopy" ejections are to be made for escape from the Blackburn NA.39 low-level strike aircraft. High-speed escape trials will be made with this NA.39 front-fuselage rocket sled at the U.S.N. China Lake track in California.

Dutch Order for F-104s

AFTER we had gone to press with last week's issue in which we surveyed current fighter replacement orders, there came news of the Dutch Government's decision to purchase Lockheed F-104G Starfighters to replace the Hawker Hunters, Republic F-84F Thunderstreaks and North American F-86K Sabres at present in service with the Royal Netherlands Air Force. This decision, taken after studies in conjunction with the Belgian Air Force, ends many speculations on the choice of fighter replacement.

It is hoped that the first F-104s will be ready for service with the R.Ne.A.F. at the end of 1961 or early in 1962. The total Dutch order, which is probably coupled with a smaller Belgian requirement, is for some 200 aircraft worth approximately £140 million. Other types studied prior to the selection of the F-104 included the Dassault Mirage 3, the Republic F-105D Thunderchief and the Northrop N-156F Freedom Fighter.

Although no official statement has yet been made on the exact production arrangements, it is understood that the Dutch industry will be well employed. Lockheed offered both Holland and Belgium F-104 manufacturing rights.

Aircraft Sales on the Baltic

FACILITIES are now provided by W. S. Shackleton, Ltd., at the Baltic Exchange in London, for the sale and purchase of transport aircraft. By appointing a representative to develop this type of business through the Exchange, Shackleton's expect to take advantage of the experience and information available to brokers working there. The value of the Exchange in the sale and purchase of ships, as well as the chartering of ships and aircraft, has already been proved.

Most airline companies are already familiar with the activities of the Baltic, and this extension of its facilities to the purchase and sale of aircraft seems no more than logical. Shackleton's representative will be able to provide immediate quotations for various types of transport aircraft together with details of operating costs and advice on the suitability of particular types for the purpose required.

Meanwhile, Aviation Exchange Inc., with headquarters in New York and a London office, has completed its first year of operations. Some 10 aircraft have been sold or leased through the Exchange during the year, and the membership now includes 100 World airlines. The latest market report (for December 24) shows 250 transport aircraft on offer for sale or lease, comprising in the main Convairs, C-46s, DC-3s, DC-4s, DC-6s, DC-7s and Constellations.

Home for Treatment

MR. WILLIAM COURTENAY, indefatigable as aviation correspondent and military lecturer, returned home by B.O.A.C. Britannia over Christmas after an eleven-months' lecture tour of U.S. Army and U.S. Air Force Bases in America, Japan, Hawaii and Korea.

During a visit to R.A.F. Hong Kong, he gave a talk with his colour movies showing the R.A.F. and Army in Aden Protectorate Operations; the new R.A.F. Base at Gan in the Maldive Islands; the ceremonies of Independence in Malaya and other activities in the Middle and Far East.

His tour ended in December with an address on an "Intelligence Report from the Far East" for Faculty and students of the top U.S. Army War College, Carlisle, Penna.—the equivalent of our Imperial Defence College. This was the first time a correspondent had been invited by the Commandant to address the College. It provided opportunity of speaking on the great rôle of British, Australian and other Commonwealth land and air forces in the Malayan campaign, and of the rôle of the helicopter in jungle warfare.

Mr. Courtenay developed pneumonia in Korea from which complications followed, due no doubt to his determination to see his tour through. He will be in Guy's Hospital through part of January for X-ray treatment. His friends will share his hope that he will be at the Virginia Military Institute again in March, among other lecturing engagements for 1960.

PACIFIC-BOUND.—Brilliant in the sunshine at Dakar, a B.O.A.C. Comet 4 refuels on a proving flight to Santiago now brought within 26 hours of London.

Photograph copyright "The Aeroplane and Astronautics"

Across the South Atlantic

B.O.A.C.'s Comet Service

by the Editor

WHEN the inaugural flight of the new B.O.A.C. Comet service to South America leaves London Airport on January 25 next it will be nearly 38 years since the South Atlantic was first crossed by air. For this historic feat the pilot, Capt. Sacadura Cabral, and his navigator, Vice-Admiral Gago Coutinho, both of the Portuguese Navy, used a Fairey III D seaplane. Exactly 14 years ago the first scheduled passenger service across the South Atlantic was inaugurated by the British South American Airways Corporation under the dynamic leadership of Air Vice-Marshal Donald Bennett. It is six years since B.O.A.C., which absorbed B.S.A.A.C. in 1949, suspended its South American operations because of a shortage of aircraft. Today there is only one jet airliner in service among the nine airlines operating services across the South Atlantic and that is the Comet, of which six have been ordered by Aerolineas Argentinas. The Comet 4 is also to be used by B.O.A.C. which by so doing will have introduced the type into three continents within three months.

The introduction of the Comet means that the journey, which originally took 77 hours from London to Santiago de Chile and necessitated night-stopping, can be flown straight through from London to Santiago de Chile in 26 hours. According to present plans, Mr. Duncan Sandys, Minister of Aviation, who is expected to head the distinguished party on the inaugural flight, will make the outward flight to the normal schedule but will come home by stages so that he may have discussions with his opposite numbers in the countries along the route. There will certainly be plenty to discuss, for the British Overseas Airways Corporation is going to have a hard struggle to make a success of its reinstituted service. It will need all the good offices of our hard-hitting Minister to ensure that it operates with the minimum of handicaps. It is no secret for instance that the Corporation will be unable to use Rio for many months yet.

It is well known also that, even without B.O.A.C. and its Comets, too many seats are chasing too few passengers across the South Atlantic. It is only recently that the Secretary-General of I.A.T.A. took the chair at a meeting of airline presidents and chairmen in order to restore some order into the booking side of the business. This had reached a stage where would-be passengers expected to open negotiations, so gossip had it, at a 40% discount.

There are three main air routes between Europe and South America: by way of the Azores, by way of the Cape Verde Is. and by way of West Africa. That by way of the Azores is used for services to Venezuela and Colombia and will therefore be regarded as outside the scope of this review since the latter is concerned with the reinauguration of the B.O.A.C. service down the East Coast of South America and over the Andes to Chile. Such services as pass through the Cape Verde Is. to Recife are of interest but not those which go to Paramaibo and Caracas.

According to the current issue of the *ABC World Airways Guide* there are nine airlines offering services over the routes we have defined in the earlier paragraph. They are enumerated in Table 1 together with the aircraft used and the frequency of return services per week. By multiplying the capacity by the frequency the total number of seats on offer may be found.

TABLE 1

Line	Termini	Aircraft	Weekly return frequency	Capacity
Aerolineas ..	London/B. Aires ..	Comet ..	2	65
Air France ..	Paris/S. Paulo ..	Superconnie ..	1	58
Air France ..	Paris/B. Aires ..	Superconnie ..	3	51
Alitalia ..	Rome/B. Aires ..	DC-6B ..	2	79
Iberia	Madrid/B. Aires ..	Super G. ..	1	55
K.L.M. ..	Amsterdam/Santiago	DC-7C ..	2	54
Lufthansa ..	Hamburg/Santiago ..	Superconnie ..	2	60
Panair do Brasil	London/Rio	DC-7C ..	1	47
Panair do Brasil	Beirut/Rio	DC-6C ..	2	60
Panair do Brasil	Paris/Rio	DC-7C ..	1	60
Panair do Brasil	Dusseldorf/Rio ..	DC-7C ..	1	60
S.A.S.	Stockholm/Santiago	DC-7C ..	2	57
Swissair ..	Zurich/B. Aires ..	DC-7C ..	1	51
Swissair ..	Zurich/S. Paulo ..	DC-7C ..	1	51

It will be seen from this table that when B.O.A.C. start their service they will offer the only through jet service to Santiago, for the Comets of Aerolineas only go as far as Buenos Aires. On the other hand Santiago is linked with Amsterdam by K.L.M. and with Hamburg by Lufthansa and with Stockholm by S.A.S.

To the existing total of seats per week (1,285), B.O.A.C. are going to offer another 126 seats a week each way. As we have said already so many seats are chasing so few passengers that special inducements have until recently been introduced to secure traffic.

It will be some time before it can have much competition. Mind you, even in an aeroplane so excellent as the Comet, the five-abreast seating and the close pitching of the seats in the tourist accommodation are not calculated to make for luxury travel. If you want that you can pay first-class fare and get it.

There are those who reckon that the only travelling on the South American route is done by those with expense accounts or large private means. In which case it may well prove beneficial to increase the first-class accommodation.

To give some idea of actual traffic figures achieved we provide an analysis (Table 2, page 31) made from the last set of complete figures available to us. These are those issued by I.C.A.O. for the month of September, 1958; this period is towards the end of the peak season and may therefore be expected to give a favourable slant to the situation.

These sort of figures do not make much of a showing with those now being achieved across the North Atlantic. Results were given in our issue for December 4 last and covered the third quarter of 1959. A total of nearly 750,000 seats were offered, of which over 520,000 were used; traffic across the South Atlantic is only a fraction of this.

Clearly, whatever B.O.A.C. does succeed in doing on the South Atlantic it is not going to add much to its total revenue figures. The fact that it has been so long in going back to reinstitute its suspended services is regarded by many as an indication that the real pressure for the resumption of the service has come from those, and that must include the Government departments, who are anxious for more drive in our efforts to expand trade with South America.

It will be obvious even from this cursory examination that if the justification for the resumption of B.O.A.C. services were to be sought only in the likelihood of increased traffic across the South Atlantic the Corporation would be hard put

to find supporting evidence for their decision. Let us then take a look at the general situation in Latin America and then we may see why there is so much pressure for the resumption of a British service.

Latin America has quite a substantial share in World trade; taking the figures in millions of U.S.$, for 1958 the World's totals are: exports 96,060 and imports 100,735; to these Latin America contributes 8,168 and 8,439 respectively. The eight countries which represent the main markets for the United Kingdom are Argentina, Brazil, Chile, Colombia, Cuba, Mexico, Peru and Venezuela. In these countries the U.K. share of imports varies between 3 and 10%.

It will be seen that the countries whose capitals are linked, or are to be linked, with London by the resumed B.O.A.C. service are Argentina, Brazil, Chile and Uruguay; relative populations of these countries are, in millions, 20, 63, 7.4 and 3.

People who are familiar with affairs in the countries of Latin America will tell you that in the past two years there has been a marked increase in their confidence in the United Kingdom's ability to supply the needs of Latin America. This, no doubt, is to be traced to an appreciation of the economic recovery in our affairs and to a growing realization that the United Kingdom is taking a greater interest in the area than at any time since the last war began. It is true our investments in the countries are not large and British investors do not have very happy memories of their experiences. But even here there are signs of a change.

As elsewhere in the World today the dominant urge in Latin America is to industrialize. Already the populations of the capital cities form a remarkably large proportion of each nation. Buenos Aires counts 3.7 million, Rio 2.9 million, Santiago 1.6 million and even Montevideo, the capital of Uruguay which has 3 million inhabitants, counts over 900,000. The determination to create and expand local industries primarily to improve standards of living and to provide employment means that a welcome is forthcoming to those who will set up businesses locally and employ labour there. The exuberance of such expansion becomes apparent to the visitor to such a city as Sao Paulo whose multi-lane motorways and polymorphic skyscrapers rival any to be seen in the World. Against such a background the decision by Rolls-Royce to set up a plant on the highway to Vira Copas, the new international airfield 50 miles to the north-west of Sao Paulo, for aero-engine maintenance in South America, becomes easy to understand.

This kind of interest in advanced industrial expansion will certainly demand a healthy flow of professional specialists between Latin-American countries and Europe. If a country has not got the swiftest and most reliable links with its interests in Latin America it will lose out to its competitors. How vigorous this threat is was made apparent in a conversation with an American official in Santiago when our discussion turned on the success of the Japanese in doing business in Chile.

From the top of the modern skyscraper hotel where we were drinking our beer during this protracted conversation the serried tops of the Andes seemed within reach of the elegant swimming pool beside which we were sitting. From their steep sides to the city spread like the level waters of a lake the well treed and watered fields of the countryside. And strangely like rocks in a lake, scattered over the level plain were the hills which in isolated groups stand up to heights of 3,000 ft. Two such blocks are noticeable as being in line one at each end of the single runway at Santiago. It makes for confidence on the part of aircrew and passenger alike to fly in a machine like the Comet with its ability to get off the ground with so short a run and climb so swiftly. An unforgettable view swings beneath as one circles for 20 minutes or so to gain the 30,000 ft. necessary for safe flight over the Andes.

This question of aerodromes seems likely to be one which will occupy much of Mr. Sandys' attention during his visit. It is inadequate runway surface which is preventing the use by the Comets of Aerolineas Argentinas and of B.O.A.C. of the single-runway aerodrome at Galeao (pronounced Galleyoun) at Rio de Janeiro. This is being repaired and lengthened so that it may take the Boeing 707 aircraft ordered by Panair do Brasil. These are expected in the summer and there seems to be some coincidence in the dates estimated for the opening of the runway for the Comets and the introduction of the 707 into service. At present the "Seven Seas" of Panair do Brasil take 24 hours on the London/Rio service whereas the Comets are scheduled to do the journey in 18.

Meantime the Comets of B.O.A.C. are fortunate in being able to use the military airfield at Cumbica, near Sao Paulo, where every assistance is received from the Commandant Col. Faria Lima. Arriving over this tumbled country with its ring of serrated mountains one is reminded of Uganda, the soil is Devonian sandstone, rock red, and the vegetation has all the dark rich green of the African tropics. Reminiscent too is the weather, and the effect which a sudden downpour of rain can have on visibility. Cumbica has a single runway and so have some of the alternates.

While we were letting down for a practice approach to the forbidden aerodrome at Rio we were warned off because of that unfortunate accident in which a training aeroplane, whose pilot successfully baled out, rammed a Viscount which was lost with all on board. This was an unpleasant reminder that it is not much fun flying to an alternate some thousand miles away or more, to find that a local crash has blocked the only runway.

This is not the only matter of concern to airline captains. Radio aids as they are understood in Europe are conspicuous by their absence. It would be interesting to know exactly how many aerodromes along the route can provide facilities for ILS or GCA. Precious few, we suspect. Indeed, on one occasion a pilot of our acquaintance went along to the control tower at one international field to watch while an ILS approach was being made only to find that, as he suspected, the ILS equipment was unserviceable. This was because a component had been damaged by water and it was not the job of the airport authorities but of the Government to replace it. It is an interesting matter of fact that although a goodly number of M/F beacons are shown on the appropriate maps, these cannot always be relied on as some of them, being privately owned, are only switched on for utilization by the line which owns them. Radar surveillance to European standards is unknown and so is air traffic control. So far as B.O.A.C. is concerned things will get better as the Corporation gets its own DME installed.

Enough has been said to make it clear that B.O.A.C. is returning to its former South Atlantic routes in not very favourable conditions. Against this it has the Comet.

(*Continued on page 32*)

Airlines	Transatlantic Eastwards					Transatlantic Westwards						
	No. of flights	Total capacity tonnes	Seats available	Seats filled	Revenue load factor	No. of flights	Total capacity tonnes	Seats available	Seats filled	Revenue load factor	Service	Stage
Air France	4	22.8	240	184	77	4	30.4	240	163	68	Paris/B. Aires	Dakar/Rio
Air France	4	22.8	240	120	54	5	38.5	300	156	52	Paris/B. Aires	Dakar/Rio
Air France	4	23.0	240	102	43	4	28.8	240	87	37	Paris/S. Paulo	Dakar/Rio
Alitalia	5	29.7	255	179	70	4	25.1	204	126	62	Rome/B. Aires	Lisbon/Sal Is./Rio
Alitalia	3	17.8	153	75	49	3	18.3	153	110	72	Rome/B. Aires	Madrid/Sal Is./Rio
Aerolineas Argentinas	1	5.3	49	48	98	1	5.3	48	40	83	Amsterdam/B. Aires	Dakar/Natal
Aerolineas Argentinas	4	21.4	192	173	91	4	21.3	192	140	73	London/B. Aires	Dakar/Natal
Aerolineas Argentinas	4	21.0	192	149	78	3	15.6	144	106	74	Frankfurt/B. Aires	Dakar/Natal
Iberia	5	33.0	370	128	35	5	38.5	370	112	30	Madrid/B. Aires	Dakar/Rio
Lufthansa	4	25.2	195	151	77	4	25.2	195	106	54	Hamburg/Santiago	Dakar/Rio
Lufthansa	5	31.5	268	126	47	4	25.2	213	135	63	Hamburg/Montevideo	Dakar/Rio
Lufthansa	4	25.2	220	61	28	5	31.5	275	82	30	Hamburg/Porto Allegre	Dakar/Rio
K.L.M.	4	30.0	220	159	72	5	37.5	275	156	57	Amsterdam/Santiago	Lisbon/Recife
K.L.M.	4	30.0	220	96	44*	4	30.0	241	162	67‡	Amsterdam/Santiago	Lisbon/Recife
K.L.M.	5	37.5	275	96	35	4	30.0	220	63	29	Amsterdam/S. Paulo	Lisbon/Recife
Panair do Brasil	9	35.9	477	159	33	9	40.9	477	265	56	Beirut/Recife	Dakar/Recife
Panair do Brasil	18	96.6	1,080	644	60	17	156.4	1,020	652	64	Lisbon/Recife	Lisbon/Recife
S.A.S.	9	63.9	459	173	38	9	63.9	459	285	62	Stockholm/Santiago	Lisbon/Recife
Swissair	8	49.6	424	317	75†	8	54.0	424	254	60	Zurich/B. Aires	Lisbon/Recife
Totals	104		5,769	3,150	54.5	102		5,690	3,200	56.2		

* One flight via Dakar 100% L.F. † One flight via Dakar 98% L.F. ‡ One flight stopped at Dakar and carried 100% L.F.

Table 2. Figures for September 1958 extracted from ICAO statistics on Traffic Flow.

For the present B.O.A.C., in conjunction with Aerolineas, can offer the supreme inducement of pure jet travel. Anybody who has flown on their aircraft will confirm that so far as the first-class passengers are concerned it is difficult to imagine any more hedonistic form of travel. One sprawls at ease in an almost silent cabin high above the main mass of clouds and in consequence in the brilliant sunshine of seven miles up.

In passing we cannot miss recording that the traveller in the Comet may still see clouds above him. This is not surprising in view of the fact that the World Height Record for gliders is 45,000 ft., showing how high up-currents of considerable strength are to be found in the atmosphere. For this reason it is good to find the enthusiastic reception given by the captains of B.O.A.C. to the Cossor cloud-collision scope, which not only provides the captain with a clear view of thunder-clouds ahead but can also be used to provide ground-mapping facilities. We noted these with interest when making the descent for a night-landing at Dakar during our return on one of the recent proving flights.

It may be noted here that the tourist section gets quite noisy when the throttles of the Avons are pushed forward for the let-down. Under these conditions the blow-off valves open to relieve pressure at the second and seventh stages of the axial compressors. As these exhaust over the upper surface of the wing under the cabin windows there is a good deal of audible aerodynamic disturbance. None of it, however, is noticeable in the forward compartment.

From our observations along the route we think that in the Comet and its superlatively trained crews, flight and cabin, B.O.A.C. have something very much worth while to sell. There seems no reason why the new service should not get business.

In view of the low break-even figure for the Comet spectacularly high load factors will not be required for economic success. Successful operation over the route by our national airways corporation should prove the most effective way of showing the flag in countries where the opportunities for improving British trade are good. Moreover it will not require a subsidy.

New Year Honours

A SUPPLEMENT to the *London Gazette* published on December 29 contained the following civil and military New Year Honours conferred by Her Majesty the Queen.

BARON

Sir George Horatio Nelson, Bt., Chairman, English Electric Co., Ltd.

PRIVY COUNCILLOR

John Dennis Profumo, O.B.E., M.P., Minister of State for Foreign Affairs since January, 1959; Parliamentary Secretary, Ministry of Civil Aviation, 1952-1953; Joint Parliamentary Secretary, Ministry of Transport and Civil Aviation, 1953-1957.

COMPANION OF HONOUR

The Right Honourable Alan Tindal Lennox-Boyd, M.P., Secretary of State for the Colonies, 1954-1959; Parliamentary Secretary, Ministry of Aircraft Production, 1943-45; Minister of Transport and Civil Aviation, 1952-1954.

KNIGHTHOOD

Harrie Stewart Wilson Massey, Quain Professor of Physics, University College, London; Arthur Bertram Waring, D.L., chairman and managing director, Joseph Lucas (Industries), Ltd.

ORDER OF THE BATH

Knight Grand Cross (Military)

Air Chief Marshal Sir Harry Broadhurst, K.C.B., K.B.E., D.S.O., D.F.C., A.F.C.

Knights Commanders (Military)

Acting Air Marshal W. H. Kyle, C.B., C.B.E., D.S.O., D.F.C.; Acting Air Marshal H. D. McGregor, C.B., C.B.E., D.S.O.; Vice-Admiral D. E. Holland-Martin, C.B., D.S.O., D.S.C., R.N.

Knight Commander (Civil)

L. J. Dunnett, C.B., C.M.G., Permanent Secretary, Ministry of Transport.

Companions (Military)

Acting Air Marshal S. C. Elworthy, C.B.E., D.S.O., M.V.O., D.F.C., A.F.C., B.A.; Rear-Admiral D. R. F. Cambell, D.S.C., R.N.; Air Vice-Marshal E. M. F. Grundy, O.B.E.; Acting Air Vice-Marshal R. W. L. Glenn, C.B.E. Air Commodores T. N. Coslett, O.B.E., M.I.Mech.E.; E. M. Donaldson, C.B.E., D.S.O., A.F.C.; E. G. Jones, C.B.E., D.S.O., D.F.C. Acting Air Commodores R. T. Gething, O.B.E., A.F.C.; R. I. Jones, A.F.C.

Companions (Civil)

M. I. Michaels, Under-Secretary, Office of the Minister for Science; R. N. Quirk, Under-Secretary, Office of the Minister for Science; R. H. Weir, Director-General of Engine Research and Development, Ministry of Aviation; F. Wood, Assistant Under-Secretary of State, Air Ministry.

ORDER OF THE BRITISH EMPIRE

Knights Commanders (Military)

Air Marshal H. D. Spreckley, C.B., O.B.E., M.I.Mech.E., F.R.Ae.S.; Air Vice-Marshal G. L. Worthington, C.B., C.B.E.

Knight Commander (Civil)

Rear-Admiral Sir Matthew Sausse Slattery, C.B., chairman and managing director, Short Brothers and Harland, Ltd.; until recently, special adviser to the Prime Minister on the transport of Middle East oil.

Commanders (Military)

Air Commodore W. P. Stamm, Q.H.S., M.B., B.S., F.R.C.P., M.R.C.S., D.C.P. D.T.M. and H.; Captain D. G. Goodwin, D.S.C., A.D.C., R.N.; Group Captains H. J. Cundall, D.S.O., D.F.C., A.F.C.; W. R. Ford; D. B. Hatfield; J. E. Johnson, D.S.O., D.F.C.; T. W. Kean, O.B.E., A.F.C.; T. King; J. F. Roberts, O.B.E., A.C.A.; J. B. Russell, D.S.O., O.B.E.; B. D. Sellick, D.S.O., D.F.C.; R. D. Stubbs, D.F.C.

Commanders (Civil)

L. J. Davies, director of research and education, British Thomson-Houston Co., Ltd., Research Laboratory, Rugby; C. C. T. Turner, A.F.C., managing director, Irving Air Chute of Great Britain, Ltd.; P. G. Tweedie, O.B.E., Chief Inspector of Accidents (Civil Aviation), Ministry of Aviation; T. J. O'Leary, M.B., B.Ch., Royal Flying Doctor Service in Australia.

Officers (Military)

Wing Officer M. F. Arkell, W.R.A.F. (Retd.). Wing Commanders H. C. D. Blasbery; A. D. Button, B.Sc., A.F.R.Ae.S.; F. S. Hazlewood, A.F.C.; R. Hill, A.F.R.Ae.S.; L. Kendrick, A.F.R.Ae.S.; T. Knight; G. E. Langley; E. B. Loftus; T. P. McGarry, D.F.C.; A. J. Peart; A. J. Scott, D.F.M. Acting Wing Commanders B. S. Jones, D.S.O., D.F.C.; C. E. Whitaker, R.A.F.V.R. Squadron Leaders W. G. Didcote; G. A. Harrison; K. G. Hodson; P. L. Kelly, B.E.M.; J. L. Wallace, M.B.E., L.R.A.M., A.R.C.M.

Officers (Civil)

G. E. Bell, Senior Principal Scientific Officer, Ministry of Aviation; F. J. Brewin, lately Principal Inspector, Ministry of Aviation; J. Ellis, Superintending Civil Engineer, Grade II, lately Air Ministry; J. B. Parry, Senior Principal Psychologist, Air Ministry; Capt. T. B. Stoney, D.F.C., Flight Manager, Boeing 707 Flight, B.O.A.C.; A. Symon, manager, sales engineering, Bristol Aircraft Co., Ltd.; J. W. Walker, M.B.E., Chief Executive Officer, Air Ministry; P. H. Watson, Assistant Director (Engineer), M.o.A.

QUEEN'S COMMENDATIONS

Capt. W. M. Jacob, Flight Superintendent, Training, Skyways, Ltd.; Capt. J. Woodman, Senior Captain, First Class, Boeing 707 Flight, B.O.A.C.; Capt. T. McQueen Robertson, Managing Pilot, Borneo Airways, Ltd.

Air Marshal W. H. Kyle (K.C.B.); Air Marshal H. D. McGregor (K.C.B.); Rear-Admiral D. R. F. Cambell (C.B.); Air Marshal S. C. Elworthy (C.B.); Mr. R. H. Weir (C.B.) and Mr. C. C. T. Turner (C.B.E.).

Air Transport

Misrair Orders the Comet

AFTER some two years of negotiation, Misrair S.A.E., the national airline of the United Arab Republic, has signed a contract for three de Havilland Comet 4Cs. The Comet was chosen in the face of strong foreign competition, both technical and financial, and the order would have been placed some months ago had it not been for monetary exchange difficulties between Egypt and the U.K.

Deliveries of the Misrair Comets will begin about mid-year and the aircraft will be used by the Egyptian airline for its resumed Cairo-London service, suspended since the Suez operations. One of the factors which favoured the choice of the Comet, in addition to early delivery, was its flexibility; Misrair requirements ranged from Cairo-London non-stop to the short Cairo-Beirut sector.

A total of 42 Comet 4, 4B and 4C transports has now been ordered by seven operators. Other contracts are said by de Havilland to be "in an advanced stage of negotiation." These are believed to include a prospective U.A.T. order for four, and perhaps orders from Middle East Airlines (on B.O.A.C. recommendation) and Saudi Arabian Airlines.

Eagle Applies the Pressure

HAVING staked its claim—a year ago now—to operate very-low-fare services between the U.K. and points in the colonies, Eagle Aviation has been missing no opportunity in recent months to demonstrate its eagerness to fly passengers at these fares. In the continued absence of a Ministerial decision on the V.L.F. applications, Eagle first advertised 20 seats (and sold 13) at the proposed V.L.F. rate from Hong Kong to London in October in a DC-6C chartered to fly a party of seamen back to the U.K. This inevitably drew a protest from B.O.A.C., although it in no way broke the law.

Further protests to the Ministry of Aviation have been made by B.O.A.C. over Eagle's non-regular series of return flights to Bermuda, also at V.L.F. rates. The first of these was made on December 13, and four others are planned, leaving London on January 10 and 31, February 28 and March 13. In this case, the whole of the capacity of the DC-6Cs (88 seats for this route) is being offered on the open market. On the first flight there were 58 passengers (a few as guests of the company) and some freight.

The validity of the B.O.A.C. protest depends on the interpretation of the Air Corporations Act, 1949, which defines a "scheduled journey" as

"... one of series of journeys which are undertaken between the same two places and which together amount to a systematic service operated in such a manner that the benefits thereof are available to members of the public from time to time seeking to take advantage of it."

The latest, and likely to be the most controversial yet, of Eagle's low-fare exercises is a whole series of charter flights arranged in conjunction with the Commonwealth Union of Trade. The C.U.T., of which Sir Evelyn Wrench is president, was set up a year or so ago "for closer contact between the peoples of the Commonwealth." Membership is open to all upon payment of an annual subscription of £3 10s.

For members of the C.U.T. only, Eagle is providing a series of "closed-group" charter flights to Nicosia, Singapore, Hong Kong, Nairobi and Malta in the next four months at V.L.F. rates. These are, in general, about 50% below existing tourist class fares. The services will be flown with DC-6Cs; normal reductions are available for children and the free baggage allowance is 33 lb. There will be departures from the U.K. for Nicosia, Singapore and Hong Kong on the 1st and 16th each of February, March and April, returning from Hong Kong on the 6th and 21st of each month. Departures for Malta and Nairobi will be on January 28, February 11 and 25, March 12 and 26, and April 11 and 26, with returns from Nairobi two days later in each case.

The points at issue here are likely to be the status of the C.U.T., and the extent to which Eagle and travel agents invite the general public to become members as a means of obtaining cheap travel. In April last year, a similar but less extensive operation, involving Hunting-Clan, was held to be legal in the magistrates' court at Feltham.

The Air-freight Business

IN its year-end statement about 1959 traffic-result estimates, IATA says that World cargo traffic "may swell to a total of 1,980,000,000 tonne-kilometres, in 1960, as compared with 1,660,000,000 in 1958" and that "North Atlantic cargo loads should continue their sharply rising curve, hitting 50,000,000 kilogrammes in 1960 as compared with 25,014,771 in 1958 and an estimated 37,300,000 this year [1959]."

The question one might ask is: "How can we be so certain that the cargo loads will increase?" The Association's Director General comments in the statement to the effect that the "phenomenal development" of air cargo traffic during the past 12 months will be assisted during 1960 "by lower experimental rates for both specific commodities and bulk shipments"—but these rates are not really so very much lower and the complications of commodity selection and route-rate variations will continue to hamper the development of the business.

There will be a natural growth—as more shippers and consignees learn of the economic advantages of air freighting, as airline sales pressure continues, as paper-work decreases and as ground-handling organization improves—but there can be no real breakthrough until the whole thing is much simplified and until operators have at least some freedom to accept fill-up cargo at individually negotiated rates to suit the circumstances.

A look at the figures on the next page—based on an ICAO tabulation of scheduled-service results—will offer little sign of any continuous upward trend in air-freight development during the past 15 years. The ton-mile increase of 14% between 1958 and 1959 is a satisfactory one in relation to those between 1956 and 1958, but it is by no means a big increase. There was a jump of about 18% between 1954 and 1955, following poor years since 1951. Overall, since 1945, cargo ton-miles have increased from 75 million to 1,295 million (or by 1,630%), but the annual increases, as can be seen, have ranged quite haphazardly between 2% and 56%—if the 1946-47 increase of 125% (when very little was being doubled, anyway), is discounted.

EGYPTIAN VISIT.—In the course of its eight-week African visit for tropical trials at Khartoum and Johannesburg, the Vickers Vanguard was demonstrated at Cairo Aerodrome, where this picture was taken. Misrair is expected to reopen its Cairo-London service in the near future, using Viscounts and, later, Comets.

Air Transport . . . .

Alitalia's Plans and Problems

A NEW company is to be formed by Alitalia to exploit the growing demand for air freight and party travel charters. It will be equipped with C-47s and DC-6s which will become surplus to Alitalia's requirements following upon deliveries of the Douglas DC-8. The new company is also expected to provide much of the extra transport capacity likely to be required in connection with the Olympic Games in Rome this year.

Two more DC-8s have been ordered by Alitalia, for delivery in the spring of 1961. Deliveries of the first four are to begin in the near future. All Alitalia's DC-8s are the extended-range intercontinental model with Conway engines. The first DC-8 service will be operated on April 15, and on the same date the company hopes to inaugurate services with its Caravelle IIIs in Europe.

In a televised Press conference in Rome last month, Ing. Bruno Velani, Alitalia's director-general, reported a 40.4% increase in ton-miles performed in the year ended October 31, 1959, compared with the previous year. The overall load factor improved by 1.9% to 54.3%. Fare reductions ranging from 17% to 40% on domestic routes were announced for 1960.

Ing. Velani referred, in answer to a question, to the difference of opinion between the Italian and British governments over the need to revise the Anglo-Italian air service agreement. Alitalia regards the existing agreement (made when Italian civil aviation was almost non-existent) as completely outdated, and wants a much greater frequency of routings through London for its North Atlantic services.

A South African View

SOUTH AFRICAN AIRWAYS' announced intention of introducing economy-class fares on the Boeing 707 jet services next year is, writes a correspondent in Cape Town, a plain acknowledgement that in buying three of these 130-seater, £1,900,000 aircraft, it has taken too much hay on its fork. The airline will have to carry nearly 100 passengers on each Boeing flight if it is to make a profit when it introduces the jet on the Johannesburg-London run next October. This is based on the "break-even" load factor of 70%, which, according to the general manager of South African Railways (administrators of S.A.A.), will be necessary if the 707s are not to lose money.

If S.A.A. operates the same number of services with its Boeings as it does at present with the DC-7Bs—five a week—the jets will need to carry 26,000 passengers a year to be a paying proposition. It is estimated that this is about the number of passengers that all airlines at present carry each year from the Union to Europe.

But clearly the 707s will have to be operated with greater frequency than the DC-7Bs to be economic. The general manager has said that one Boeing will do the work of two DC-7Bs, carrying 130 passengers against the 66 of the DC-7B. But the jet is almost twice as fast as well as twice as big. It will fly a three-stop service to London in 14 hours as against 27¼ hours at present taken by a DC-7B, also making three stops. This means that one Boeing will practically do the work of four DC-7Bs. And, in effect, South African Airways will thus be expanding its Springbok service fleet threefold—from four DC-7Bs to the equivalent of 12.

During the April-August international season, there is, at present, little trouble in filling aircraft. But in the off-season South Africa's DC-7Bs leave Jan Smuts Airport regularly with a mere half-dozen or a dozen passengers. Where are the passengers to come from to fill the jets? Some members of the IATA, like B.O.A.C., our correspondent continues, want lower fares to attract more passengers; other members say that cheap fares cannot be introduced now, that costs are too high and that economy fares could not pay except at load factors which are unlikely to be achieved.

South African Airways, desperately anxious about its Boeing operations this year, has decided to take the bull by the horns and cut fares drastically. By doing so it hopes to bring international air travel within the means of an entirely new class of travelling public. If it is not successful the South African taxpayer will have to foot the bill. As it is, South African Airways, for the first time in six years, is in the red.

Operations on domestic, regional and international services during 1958-59 resulted in a deficit on the revenue account of £190,000. The importance of the Springbok service in bringing in revenue is shown by earnings of some £4 million last year out of a total revenue of £8,600,000. The three Boeings will cost the Union £6,491,050 and, in addition, there is the expenditure for nearly £1 million on a flight simulator and of £320,000 and £630,550 respectively on workshops and special equipment.

Vertical Turn-offs?

CAPT. R. C. ROBSON, who writes "Cockpit Viewpoint" for *Aviation Week*, made some mildly ironic but pointful comments in the issue of December 14.

"Jet take-offs are accomplished by 'rotating,' that is, lifting the nose, at a specific point down the runway. Otherwise, one goes smashing through the boundary fence. If all goes well, however, one clears obstacles at the boundary by several feet. But," he adds, "the Los Angeles runway, at the rotation point, starts uphill—some 25 ft. in 4,000. So the jet doesn't fly when advertised—it sort of taxies uphill out of Los Angeles International."

Traffic Estimates for 1959

ALMOST simultaneously last week the International Civil Aviation Organization and the International Air Transport Association issued air traffic estimates for 1959. Both informed guesses came from ICAO and showed something of a return to the percentage increases to which the airline industry had become accustomed in the years before 1958.

But the unanswered question is: how long will it take for traffic increases to bring in the revenue necessary to balance the overall budget and to return the industry to the mildly profit-making levels even of 1955 and 1956? In those years the average operating profit of the World's airlines, according to ICAO, was running at about 2.5%, but, since then, the airlines, taken as a whole, have suffered equivalent or even greater losses.

But there have recently been one or two more hopeful signs than that to which the industry has become accustomed during the past two years. Last week, for instance, T.W.A. announced record traffic (4,393 million passenger-miles) *and* a record income for the first nine months of 1959 with a profit, after taxes, of about $9 million by comparison with a loss of $1.1 million for the 1958 period.

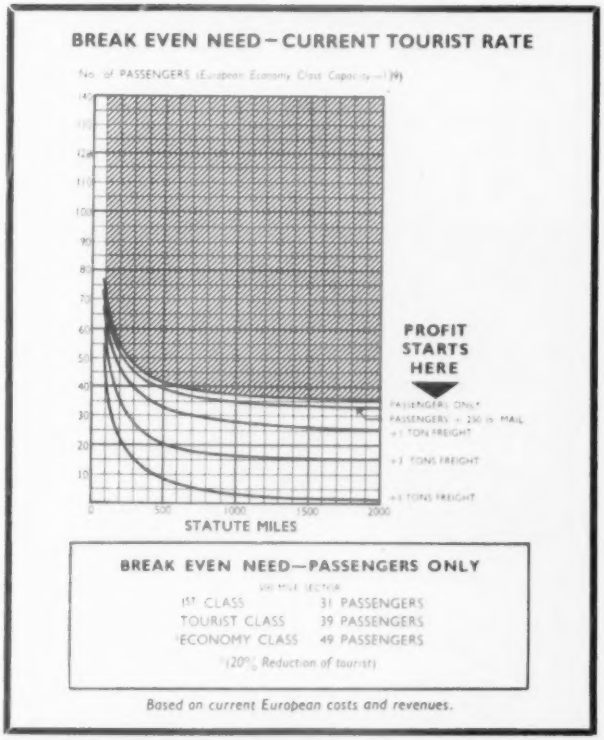
SCHEDULED TRAFFIC, 1945-58, AND ESTIMATES FOR 1959

Year	Miles flown	Hours flown	Passengers carried	% increase on previous year	Passenger-miles	% increase on previous year	Cargo* ton-miles	% increase on previous year	Mail* ton-miles	% increase on previous year	Average number of		
											Passengers per aircraft	Miles flown per passenger	Miles flown per hour
	Millions				Millions		Millions		Millions				
1959	1,875	8.6	96	10	59,000	12	1,295	14	355	11	31	615	217
1958	1,810	8.7	87	2	53,000	5	1,135	2	320	9	29	606	208
1957	1,750	8.7	85	10	50,500	14	1,110	9	295	8	29	593	202
1956	1,570	7.9	77	13	44,000	16	1,015	14	275	8	28	575	199
1955	1,415	7.3	68	17	38,000	17	890	18	255	16	27	562	196
1954	1,275	6.7	58	12	32,500	13	755	6	220	14	26	556	193
1953	1,195	6.4	52	13	28,500	15	710	5	190	12	24	553	186
1952	1,095	6.0	46	10	25,000	14	680	9	170	9	23	547	183
1951	1,000	5.6	42	35	22,000	25	625	18	160	15	22	516	180
1950	895	5.0	31	15	17,500	17	530	35	135	5	19	544	177
1949	840	4.8	27	13	15,000	14	390	36	130	12	18	547	174
1948	790	4.6	24	14	13,000	11	290	56	115	31	17	553	171
1947	710	4.2	21	17	12,000	19	185	125	90	30	17	559	168
1946	585	3.8	18	100	10,000	100	80	9	70	−23	17	528	155
1945	375	2.5	9		5,000		75		90		13	547	149

Excluding the U.S.S.R. and China. * All tons are short tons.

Only the VANGUARD

has this low-cost story


BREAK EVEN NEED—CURRENT TOURIST RATE
No. of PASSENGERS (European Economy Class Capacity = 139)
PROFIT STARTS HERE
PASSENGERS ONLY
PASSENGERS + 250 lb. MAIL
+1 TON FREIGHT
+2 TONS FREIGHT
+3 TONS FREIGHT
STATUTE MILES
BREAK EVEN NEED—PASSENGERS ONLY
1ST CLASS 31 PASSENGERS
TOURIST CLASS 39 PASSENGERS
ECONOMY CLASS 49 PASSENGERS
(20% Reduction of tourist)
Based on current European costs and revenues.

THE CONCLUSIONS to be drawn from this simple graph are among the most significant ever put to airline operators. It shows at a glance that the Vickers Vanguard will break even on total costs (indirect costs are taken as 100 per cent of direct) with passenger loads no higher than those actually carried by Viscounts today.

With three tons of freight the passenger break even requirement can be as low as 21 people falling to only 8 passengers when five tons of freight is carried for 500 miles. The Vanguard is a profitable aircraft on today's payloads yet it has room for the inevitable expansion of traffic which, even at a modest progress, makes the Vanguard the biggest potential money earner ever built.

In addition to its outstanding economy, the Vanguard is fully competitive in speed (425 m.p.h. cruise), and its turbo-prop flexibility will enable it to maintain schedules as good as any, while allowing for realistic traffic conditions.

Of all the airliners only the Vanguard has all these features

425 m.p.h. cruising • Freight capacity 7/8 tons at normal densities • Full routeing and A.T.C. flexibility • Can use normal existing airfields • Quick turn-round • No airfield noise problems • Ten years' unique Vickers/Rolls-Royce turbo-prop experience . . . ***And it is 'Viscount' quiet.***

VICKERS VANGUARD

FOUR ROLLS-ROYCE TYNE TURBO-PROP ENGINES

• ***The airliner with the biggest profit potential ever offered to the operator***

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

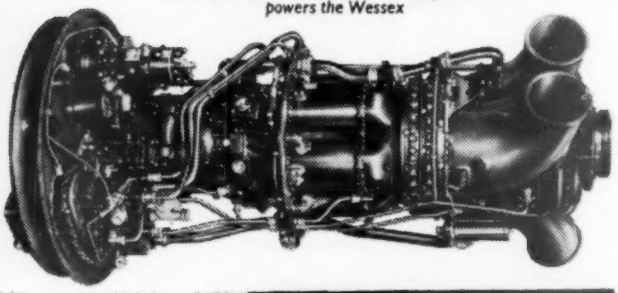
TGA AT624

C

The Westland Wessex was the first gas turbine helicopter to go into quantity production. A twin turbine development of this well proven aircraft will provide multi engine reliability and increased altitude performance.

TURBINE DEVELOPMENT

The Napier 'Gazelle' free turbine engine which powers the Wessex



The P.531 turbine helicopter is a versatile general purpose helicopter with particular application to training and to ship-borne operation.

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WESTLAND AIRCRAFT LIMITED YEOVIL ENGLAND

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Air Transport . . . .

Take-off Requirements Examined

THE appearance last month of Circular 58-AN/53 from ICAO's Airworthiness Committee marks the interim conclusion of a great deal of work on "provisional acceptable means of compliance" with the Organization's performance standards as applied to present-day aircraft. It is the final result of three meetings of the Committee—in October-November, 1957; July, 1958; and July-August, 1959—and is designed to form the basis of national airworthiness codes.

Since the safe take-off performance of four-jet transports offered one of the more critical problems dealt with by the Committee, this might be a suitable moment to publish an explanation prepared by the International Federation of Air Line Pilots' Associations in September of last year. Federation representatives have taken a vital part in the formulation of performance standards, at these meetings and elsewhere, and IFALPA's comments on the new performance requirements for take-off can be treated as a reflection of the considered opinions of airline pilots.

The take-off case today is largely dominated by the requirement that an aeroplane must leave the ground at 1.15 times (piston-engined aircraft) or 1.2 times (turbojets) the power-off, free-air stall. The essential difference in the case of the new code is that this condition is not required to be met until the aircraft is 35 ft. above the runway.

Thus, between the surface of the runway and 35 ft. is a segment not protected by a 15-20% margin above the stall; however, other protection has been provided by the new specifications and is claimed by the governmental experts to be as good as previous margins and certainly adequate to prevent difficulty in getting airborne or "sinking" once in the air. An exact comparison of the old and the new specifications is complex since the datum and the technique applied to take-off have been fundamentally changed.

The important speeds associated with the old take-off code were: (1) the stall (Vs1); (2) the minimum control speed (Vmc); (3) the decision or power-failure speed (V1); (4) the take-off safety speed (V2); and (5) the initial climb speed (V2 or V2-plus). There were various connecting links between these speeds but the one usually dominant was that V2 had to have a 15% (piston) or a 20% (jet) margin above the stall.

The important speeds associated with the new take-off code are: (1) the stall (now Vs); (2) the minimum control speed (Vmc); (3) the engine failure *recognition* speed (V1); (4) the minimum unstick speed (Vmu); (5) the rotation speed (Vr); (6) the unstick or lift-off speed (Vlof); (7) the minimum take-off safety speed (V2 min.); and (8) the initial climb-out speed (V2). The overriding points are that lift-off (Vlof) is governed by 12% above minimum unstick (Vmu) and is (in the normal case) assisted by ground effect; and that V2 min. (the old V2), with its 20% (jets) margin above the free-air, power-off stall, is now not specifically required until an altitude of 35 ft. has been reached.

The important newcomers are Vmu, Vr and Vlof, and their connection is as follows:—

Unstick, or lift-off, and all speeds up to the 35-ft. height point (at which V2 min. is reached) are mainly dominated by Vmu. This is a speed used only in certification trials and is the lowest at which the aeroplane can be made to leave the ground and climb away safely. It should be substantially above the stall, but it is difficult to relate to the stall because: (1) most aircraft gain from ground effect (usually considered to apply up to half-wing-span height) and it may therefore be possible to unstick at or very near to the stall, which is a free-air, power-off figure; and (2) the stall itself, as measured in U.S. certification trials, is not the same as the stall known to pilots and can, in fact, be much less (i.e., Comet 4, 5 kt.; DC-7, 7 kt.; and KC-135, 9 kt.). Anyhow, the fact remains that a test pilot must demonstrate that, for various weights, the aircraft can be made to unstick at Vmu. This figure is then multiplied by 1.12 to give the lift-off speed. This is "the speed at which the aircraft first becomes airborne" and is the speed applied in the normal operational take-off.

The rotation speed (Vr) is the lowest speed at which the nosewheel should leave the ground. However, the rotation speeds currently being applied to jets are based on the American SR422 code and thus associated with the old V2 (usually Vr equals V2 minus 5-10 kt.) while the new rotation speed is not directly related to V2 but to Vmu, as described above. It is also related to the stall (1.1 Vs) and to the minimum control speed (1.05 Vmc), but these will not usually be dominant.

Summarizing, once the nosewheel has been raised at a speed between Vr and Vlof the aircraft should climb away, reaching V2 min. speed by 35 ft. or earlier. On leaving the ground the most likely dominant protection is the 12% above the "worst leaving condition" (Vmu) and, at 35 ft., the dominant protection is approximately the same as we have always had at the old V2—though with, perhaps, a small loss due to slipstream effect being greater than the 5% allowed for as between the 1.15 Vs1 (piston) and 1.2 Vs1 (jet) specification.

Additional protection at Vlof is, however, provided by applying a 6% margin above the engine-out Vmu and a 5 kt. premature rotation must not lengthen the take-off run; these could, in some cases, prove dominant.

IFALPA has questioned the adequacy of the 12% above Vmu margin on the ground that so little was known of how Vmu speeds would relate to the stall speed as pilots know it (i.e., the zero-rate-of-climb-speed, the max.-lift-speed, or the speed-at-which-the-nose-drops). This speed directly affects the lift-off point and, in view of the fact that nearly all jet take-offs are critical from the point of view of runway length, is fundamental to the whole operation.

In view of the forthright assurances from the certification authorities, the lack of specific reports that existing jet performance standards are unsatisfactory and the positive improvements made, during the Committee's discussions, to those standards (e.g., the "positive climb" Vmu, the "conservative" interpretation of Vs, a "recognition" margin for engine failure at V1), the final position taken up by IFALPA was one of acceptance of the provisional acceptable means of compliance on a trial basis—subject to a day-to-day analysis of jet operations under the new code and, while it is still in use, under the old one.

FOR LUFTHANSA.—The first of D.L.H.'s four Conway-engined Boeing 707-420s is seen here taking off on its initial flight from Renton on December 18. Last week it was reported that Lufthansa had decided to place an additional order for the medium-range, smaller-capacity 720 for services to South America and the Middle and Far East.

Air Transport . . . .

An Airline Helicopter

LOS ANGELES AIRWAYS' recent order for five twin-engined Sikorsky S-61s is important because it means that this pioneer among scheduled helicopter operators will now become, before the year is out, the first to put a multi-engined turbine helicopter into service. Chicago Helicopter Airways more recently announced the purchase of six S-61s, but this airline is not expected to begin service with its new fleet until 1961. L.A.A. is also expected, early this year, to become the first airline in the World to have turbine-powered helicopters in service, when it puts two single-engined Sikorsky S-62s into operation, primarily to obtain gas turbine experience and to meet the company's need for a single-engined utility amphibian helicopter, supplementing its present fleet of five S-55s and two S-51s.

The S-61 continues the Sikorsky line of single-rotor helicopters, on which the company now has some two million hours of flight experience. It is a variant of the HSS-2 already in production for anti-submarine duties with the U.S. Navy, and it is designed, like the single-engined S-62, with a boat-type hull for water operations. Another version, the HR3S-1 military transport with rear-loading provision, has recently been demonstrated in mock-up form.

An unusual feature of the S-61 is that it is offered in either twin- or three-engined form. This is possible, without any major alteration to the airframe, by the location of the engines above the fuselage and immediately beneath the main rotor. The engine housing contains two engines side-by-side ahead of the rotor, and driving directly into the main transmission gearbox. The third engine, when fitted, is mounted behind the rotor, and is of most value for high temperature or high altitude operation, since the transmission can accept the full power output of only two engines in standard day conditions at sea level.

Present versions of the S-61 are based on three General Electric CT-58-100s (commercial model of the T58-6) or two T58-8s. The former weigh 271 lb. each and have a maximum continuous rating of 900 s.h.p.; the 5-min. take-off and 30-min. contingency rating is 1,050 s.h.p. The T58-8 weighs 275 lb., has a continuous rating of 1,050 s.h.p. and a take-off and contingency rating of 1,250 s.h.p. The T58 is expected to have an inter-overhaul period of 1,000 hours by the end of 1963. Both L.A.A. and C.H.A. have ordered the twin-engined S-61.

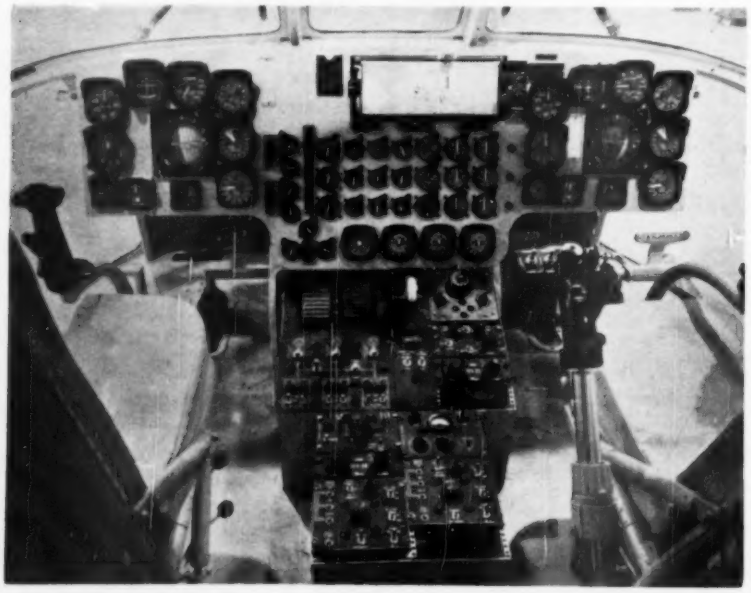
The five-blade rotor follows Sikorsky practice, with metal main blades all fully interchangeable. Sikorsky are able to guarantee a 1,000 hr. overhaul period on the main components

—main and tail rotor assemblies and main, intermediate and tail gear boxes—when commercial deliveries begin at the end of the year, thanks to the military development programme started in 1958.

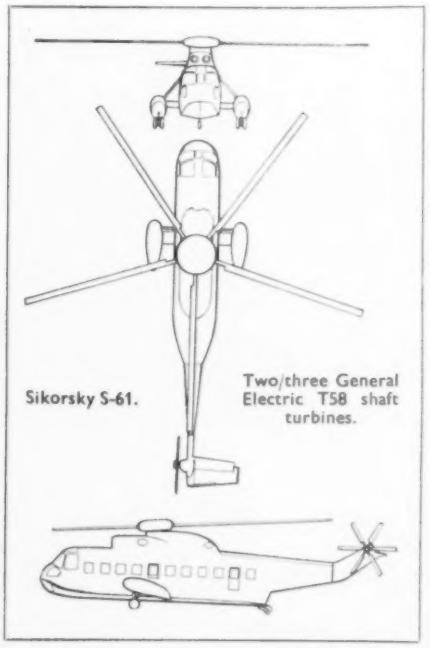
The tests already started include a 1,510-hour programme of whirl testing on the main and tail rotors and 1,250 hours of full-load back-to-back testing of the gearboxes (to be completed by September, 1960) and 1,450 hours of tie-down tests on a complete helicopter by November, 1961. Whirl tests will continue until April, 1961, and the Navy requires 2,700 hours of type-testing on the HSS-2 by mid-1960. In addition to these tests, Sikorsky is running a complete engine test stand with main rotor and transmission.

Considerable attention has been given by Sikorsky to the design of the cabin, and Raymond Loewy Associates have been retained to design the interior appointments and the exterior colour scheme for the prototype. The basic interior arrangement is for 25 passengers and a cabin attendant; with one exception the passenger seats are forward facing, in double or single units at 34-in. pitch. The L.A.A. S-61s will seat 28 passengers, and the C.H.A. helicopters, 25. The two rearmost seats in the cabin can be replaced by a toilet, and a hot-meal galley unit can be installed in place of the single seat opposite the main (starboard side) entrance door which incorporates built-in stairs.

All basic layouts include a 100 cu. ft. baggage compartment



Layout of the instruments in the S-61 cockpit is described in the text. In this picture of the mock-up (shown also at the top of the page), the Decca Flight Log is clearly shown.



Sikorsky S-61.

Two/three General Electric T58 shaft turbines.

immediately behind the flight deck, accessible externally from starboard. Additional baggage or cargo space can be provided by using a movable bulkhead in any one of four positions, with 23, 20, 17, or 14 passengers and, respectively, 149, 245, 346 and 446 cu. ft. of cargo volume. Independent heating and air conditioning systems are provided for cabin and flight deck.

On the flight deck the two pilots are separated by the central console containing the radio, navigation and automatic stabilization equipment (ASE) controls. Completely duplicated flight instruments are provided on each side of the panel, grouped around a 5-in. attitude indicator. Immediately above the latter instrument are the absolute altimeter and the four-axis null indicator giving forward, sideways and vertical velocity; the compass is in the top right corner. Below the compass on the right are the engine performance indicator and tachometer. From top to bottom on the left are the basic instruments—A.S.I., rate of climb, and turn and slip indicators.

Between the two panels, space provision is made for a Decca Flight Log, with engine instruments, transmission and hydraulic gauges and Decometers below. Also optional is the Sikorsky ASE, which provides the same functions as an autopilot with the addition of special helicopter functions such as a means for coming to a hover automatically.

Special attention has been given to ease of servicing the S-61. All ground servicing points are located on the port side, away from passenger and baggage loading doors, and standard cargo-handling equipment, including fork-lift trucks, can be used to load freight. Optional parts can be provided to allow the port front engine to drive the accessory section of the main gearbox without turning the rotor, in order to provide hydraulic and electrical power on the ground.

Although the whole fuselage of the S-61 is designed as a hull for water operation, in sea states up to mid-2, the float-equipped retractable main undercarriage can be replaced by a simple, fixed land undercarriage when amphibious capability is not required, at a weight saving of 297 lb. If a fixed gear is used with the floats, 40 lb. can be saved compared with the retractable installation. Deleting the third engine saves 791 lb. on the empty weight of the standard aircraft.

Price of a fully equipped S-61 has been quoted by Sikorsky as "in the neighbourhood of $650,000." Seat-mile operating costs have been estimated by Los Angeles Airways to be less than one-half those of present piston-engined helicopters.

Design Data

DIMENSIONS: Main rotor diameter, 62 ft.; tail rotor diameter, 10 ft. 3½ in.; overall length, 72 ft. 9 in.; overall height, 16 ft. 10 in.; fuselage length, 59 ft. 7 in.; width (except rotor), 16 ft. 9 in.; cabin length, 31 ft. 11 in.; cabin width, 6 ft. 6 in.; cabin height, 6 ft. 3½ in.

WEIGHTS: Rotor group, 2,113 lb.; tail group, 185 lb.; body group, 2,451 lb.; undercarriage group, 759 lb.; engine section, 163 lb.; powerplant group (3 engines), 2,992 lb.; trapped fluids, 126 lb.; fixed equipment group, 1,417 lb.; standard aircraft weight empty, 10,206 lb.

Typical optional equipment, 1,304 lb., typical operational weight empty, 11,510 lb.

Crew (three), 490 lb.; passengers (25), 5,000 lb.; fuel (100 naut. mile sector), 1,677 lb.; oil, 69 lb.; typical operational gross weight (3 engines), 18,746 lb.; typical operational gross weight (23 passengers, two engines), 17,704 lb.

PERFORMANCE (3 engines, I.S.A.): Cruising speed (20,000 lb.), 115 knots; best rate of climb (20,000 lb.), 1,500 ft./min. (1,400 ft./min. with one engine inoperative); vertical rate of climb (18,000 lb.), 950 ft./min.; hovering ceiling (o.g.e., 18,000 lb.), 12,000 ft.; hovering ceiling (i.g.e., 18,000 lb.), 15,000 ft.; service ceiling (20,000 lb.), 13,000 ft.

PERFORMANCE (2 engines, I.S.A.): Cruising speed (20,000 lb.), 115 knots; best rate of climb (20,000 lb.), 1,450 ft./min. (150 ft./min., one engine inoperative); vertical rate of climb (18,000 lb.), 1,000 ft./min.; hovering ceiling (o.g.e., 18,000 lb.), 8,000 ft.; hovering ceiling (i.g.e., 18,000 lb.), 11,500 ft.; service ceiling (18,000 lb.), 11,000 ft.

1959—the Turning Point?

by R. H. Ayers

IN due course the statisticians will produce summaries of United Kingdom air traffic for the year 1959 and these will undoubtedly show a trend which is very pleasing to the aviation business. But there have been a whole series of events affecting the U.K. during 1959 which may seem to be insignificant taken separately, yet which, taken collectively, may point to a rise in passenger air traffic greater by far than any commercial manager has dared to plan for.

Increasing desire for travel has been a feature of the development of our present civilization and the only concern of aviation is to increase its share of this total of travelling public—the total itself inevitably increasing year by year. The competing methods of travel, namely road, rail and boat, still handle the bulk of passenger traffic over European routes emanating from the U.K. which are also served by air. It is doubtful whether any valid statistics are available in making a comparison, but I would venture to suggest that over 90% of the total is still carried by surface methods.

This means that there is a tremendous potential for the expansion of passenger air traffic and I hope to show why the events of 1959 have done much to break down the two main reasons why the bulk of the travelling public use surface transport in preference to the aeroplane. In order of importance these two reasons are, first, fear of air travel and, second, fear of the cost—a fear often brought about by lack of proper comparison.

The most important event of 1959 took place within the aviation industry itself. Last year marked the ultimate realization by the industry that, given a proper fare structure, aviation can become the medium for mass travel. With reasonably high density seating and a full aeroplane, air travel can compete on level terms with surface travel if the full cost of a surface journey, including meals, is taken into account.

If proof of this point is needed the advertisement of one charter company may be quoted which offers to carry a full Britannia load of passengers to any part of the World for 2d. per mile per person.

Although this possible low cost of air travel is often attributed to, and used as an excuse for the purchase of large modern aircraft, it is in fact nothing new. A full Dakota can compete on many routes with surface travel as regards cost. What is new is the 1959 philosophy of the major airlines that their future lies in providing transport for the masses in full, high-density seating aircraft at low prices, as against the post-War philosophy that flying was a luxury for the wealthy.

The second 1959 event which relates to this aspect of aviation was the return of the present Government with their policy of encouraging a lower fare structure and with their apparent intention of giving private enterprise the opportunity of providing some healthier competition with its more efficient administrative organization.

Added to these factors we saw in 1959 the weakening of the rival forms of transport by the increase in rail fares and the increasing congestion of traffic both on the roads in the U.K. and on the Continent. Road congestion is not only putting up the cost of road transport but is having a very significant psychological effect on would-be holiday makers who find that a holiday with a car is no longer an en route pleasure, nor does it necessarily provide relaxation at the destination.

The 1959 economic situation in the U.K. was a very significant factor. Although the decrease in airline fares had not started, many people of average income were able to afford the benefits of air travel either through inclusive tours or on scheduled services. From observation it seemed that about 50% of the 1959 air travellers were flying for the first time and, what is more important, were enjoying every minute of it. After fighting for seats and humping their baggage on trains and boats, the V.I.P. service of airline travel was a revelation.

This situation of having such a large proportion of new and satisfied customers is very important. Airline business is of the snowball type—growing far more by personal recommendation than by advertisement, and each satisfied customer in 1959 will mean two or three customers this year if the price barrier is broken down.

Why were the 1959 customers, almost without exception, satisfied? Because our fickle British climate played its part better than ever before. Two of the most important factors in ensuring the mass satisfaction of the passengers on any flight are, first, a punctual take-off and, second, a smooth flight. The 1959 weather provided conditions which could almost ensure both. Any fear which the newcomers to aviation may have had was dispelled and replaced by an enthusiasm for this form of travel in which free meals can be enjoyed in comfort without the constant shaking of road, rail or sea travel.

Since air travel, up till now, has only scratched the surface (pardon the expression) of the mass-travel market, the cumulative effect of all these favourable circumstances, which synchronized themselves in 1959, must be that of opening the floodgates for expansion of our industry. If aviation can avoid the pinpricks which annoy the traveller—such as separate airport charges payable on the spot—it can look forward to a very prosperous 1960 and years to follow.

Impressions of the Macchi 326

by T. Frost*

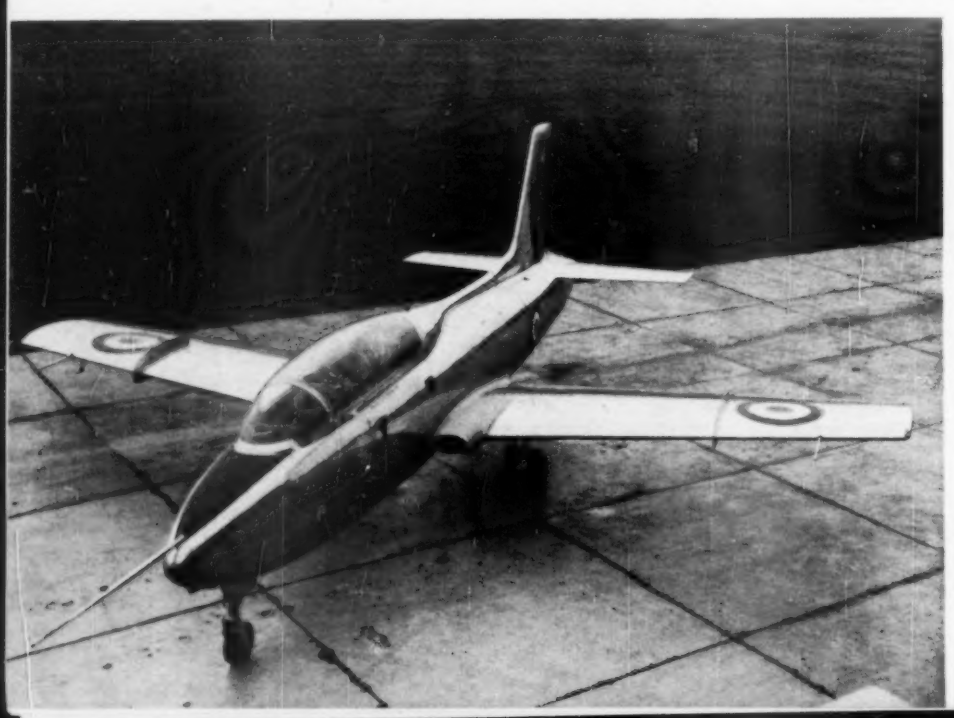
AS test pilot to an engine manufacturing company, my opportunities for dealing with a brand new aircraft *in toto*, as it were—rather than concentrating on the strictly powerplant side of things—do not occur all that often. Over the past year, however, I have had the very pleasurable experience of first-hand dealings with Aeronautica Macchi, and the opportunity of flying the Viper-powered Macchi MB 326, which is on order for the Italian Air Force as their standard basic trainer.

Some readers will doubtless recall the very lively performance—including some hair-raising 7*g* turns—which this aircraft put up at the Paris Salon last June.

My first sight of this aircraft was in May, 1958, when a small party of us from the Flight Test Department went out to Venegono in Northern Italy to discuss the Viper 8 installation in the first prototype machine. Unfortunately, on that particular occasion, we only managed a two-day visit but, although the greater part of our time was spent in looking into such matters as engine r.p.m., jet pipe temperatures, fuel flows and the like, we still managed to get in some general and familiarization work on the airframe. As a result, we were in a position to make what we hoped were constructive suggestions on various odd mods concerning such things as cockpit layout and instrumentation.

As I have already mentioned, the first prototype was powered with the Viper 8. This delivers 1,700 lb. thrust and, in consequence, the aircraft, although delightful to fly, was slightly underpowered. Perhaps it might not be out of place to say here that, in my experience, the Macchi 326 is one of the most

* Chief test pilot, Bristol Siddeley Engines, Ltd.



Intended as a basic trainer suitable for both *ab initio* and advanced instruction, the Macchi MB 326 is in production for the Italian Air Force. It is powered by a Bristol Siddeley Viper turbo-jet; note the extended wing-root intakes.

The clean overall lines and elegant cockpit canopy of the Macchi 326 are apparent in this air-to-air shot (left) and the side view (below).

pleasant basic trainers that I have yet flown—but more of that later.

What interested me was the philosophy behind the design of the aircraft. In producing a machine of this type, Macchi aimed to cater for the whole range of training requirements, from *ab initio* work to advanced flying techniques. This means, of course, that the company has had to embody in one aircraft two entirely different sets of flying characteristics; and the compromise has certainly been effected with remarkable success.

Not only has one got an aircraft—in its present form, that is—with low take-off and landing speeds but with the Viper it is possible to enjoy high-performance climbs and excellent speed characteristics. Being pressurized—a great advantage this—normal aerobatic training can be done, say, on the 15,000-25,000-ft. level, and navigational training can be completed with maximum fuel economy within the 25,000-40,000-ft. range. Furthermore, the fact that the aircraft is also designed to fly at around Mach 0.8 means that a large proportion of advanced flying techniques can also be satisfactorily handled.

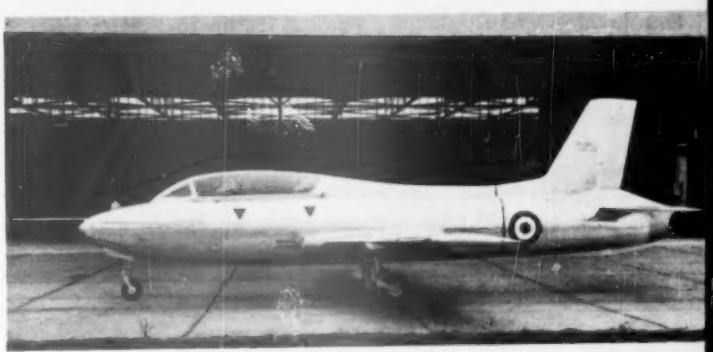
On June 5, last year, just over a year after our first visit, we went out to Italy again to see how things were going with the second prototype. This aircraft differed from its elder brother in that the Viper 11 of 2,480 lb. thrust had been fitted.

In taking the machine into the air, it was clear that we would have no further trouble with the power/weight ratio, which was ideal. Also the modifications which had been suggested during the first prototype trials had been incorporated.

With the increased thrust of the Viper 11, aircraft acceleration at take-off was obviously more rapid and the take-off run appreciably reduced. Nevertheless, both take-off and landing proved extremely straightforward. Stick forces were light and the aircraft responded rapidly to all controls. Moreover, the touch-down speed was extremely modest—just on 85 knots—and the trim changes necessary with wheels and flaps down were negligible.

Stalling characteristics both in the "clean" and landing configurations proved to be extremely mild; pre-stall buffet in the former case was evident at 10 knots above the stalling speed and something in the region of seven knots in the latter case. As a matter of interest, the natural stalling speed in the landing configuration, with the stick held right back, was 80 knots.

Unless positive action was taken, the 326 was reluctant to spin and to do so inadvertently was well-nigh impossible. Recovery, too, was both quick and easy to effect.



We found Macchi very pleased with the performance of the Viper 11. The fact that the engine accelerated very rapidly from starting to idling r.p.m., and that swift, stall-free, accelerations were possible at all altitudes up to 40,000 ft., was something which impressed them very much. Another thing that had obviously struck them as remarkable was that it was possible to achieve a high degree of engine r.p.m. control governing at part throttle opening as well as at the full throttle setting.

At the beginning of October last, we returned to Venegono for the third time, on this occasion for the re-light tests—which proved, in fact, to be very successful. By this time the Viper 11 had completed somewhere around 90-100 hours in the second prototype, and over the entire period it had been necessary to make only an adjustment to one minor component.

Our relations with the Macchi flight test team were excellent and, before going home, I had the stimulating experience of being taken through all the aerobatics in the book by their chief test pilot, Commandant Carastiato. This was concluded by a low-level exercise which had as its grand finale a couple of 6*g* turns—practically splitting the ears of corn in a field near the airfield with one wing tip and putting the aircraft deftly through a horrifyingly small gap between two of the airfield's hangars!

Two widely different helicopter types built by Saunders-Roe—a one-man Rotorcycle hovers near a six-seater Wasp for the Royal Navy.

Rotorcycles by Saunders-Roe

AIRCRAFT cost less to build in small batches in Britain than they do in America; Hiller Helicopters took advantage of this recently by arranging for Saunders-Roe, Ltd., to produce a batch of 10 XROE-1 one-man Rotorcycle helicopters. Arrangements for their production were made through Helicop-Air of Paris, Hiller's European agents.

The contract for producing these 10 helicopters was signed in November, 1958, and the first Rotorcycle built by Saunders-Roe flew at the end of October last year. Five have now been delivered and sent to the U.S. for assessment by the Marine Corps. All 10 Rotorcycles are due to be completed by Saunders-Roe by the spring of this year. The remaining five will be kept in Europe by Helicop-Air as demonstration aircraft; at least one will probably stay in Britain.

Saunders-Roe built the jigs and tools and manufactured all the gearing, transmission components and the structure using materials sent from the U.S. All proprietary items, including the engine, electrics, main rotor blades and instruments were also supplied from the U.S. and the Rotorcycles were built in accordance with Hiller drawings.

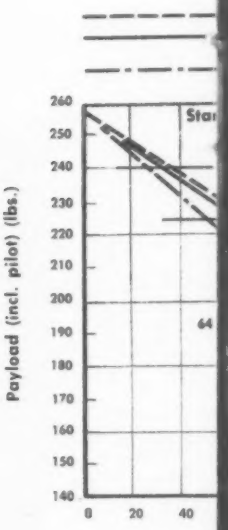
It is not known at present whether additional Rotorcycles will be produced by Saunders-Roe, but the company is obviously well placed to do so because of the jigs and tools it now possesses. Only prototype Rotorcycles have so far been built by Hiller; one of these made a European tour in 1958 and was described in THE AEROPLANE for May 16 and May 23 of that year.

Development of the craft dates back to 1954 when Hiller was selected by the U.S. Navy Bureau of Aeronautics to build a one-man helicopter for the Marines. Flight testing of prototype Rotorcycles was completed in July, 1957.

This machine represents an ingenious solution to the problem of producing a small and easily portable one-man helicopter. As a photograph on this page shows, it can easily be folded

RAPID ASSEMBLY.—Above, quick-release pins lock the tail-rotor boom of the Rotorcycle in position.

FOLDING ACT.—Left, a prototype Rotorcycle hovers above a second which is folded for transport.



for transport to form a compact package; its empty weight is only 300 lb. During demonstrations a prototype Rotorcycle has arrived in a station wagon and been unloaded and assembled ready for flight within 10 minutes. Its rotor blades and landing legs fold and its detachable tail boom is locked in position with quick-release pins.

Powered by a Nelson H43-B four-cylinder air-cooled two-stroke engine, the Rotorcycle has a two-bladed main rotor with a small servo rotor and a conventional tail rotor. The cyclic control stick varies the pitch of the servo rotor paddles; the aerodynamic forces so produced tilt the rotor head. This control technique is known as the Hiller Rotormatic system.

In place of a landing gear the craft is supported on three tapered aluminium-alloy spring tubes. Despite its foldability, the structure is so simple that the disposable load is almost equal to the empty weight.

Although commercial applications may well be found for the Rotorcycle, it has been designed basically for military use. Military rôles could include advanced reconnaissance, cable laying, courier work (in which it could replace the despatch rider) and the supply of light equipment; it has also been suggested that it might be air-dropped as a rescue vehicle or used to move patrols and assault troops into enemy-held areas. In practice, its use in those rôles may be limited, as all who fly it will need to be trained as helicopter pilots.

Possible commercial uses include whale spotting and crop spraying. But it is unlikely to be economic for civil use unless ordered in quantity for military duties; a long production run will permit the price of the Rotorcycle to be reduced and this will make it a much more attractive commercial proposition.

Technical Data

Dimensions.—Rotor diameter, 18 ft. 6 in.; height, 6 ft. 11 in.; tail rotor diameter, 3 ft.

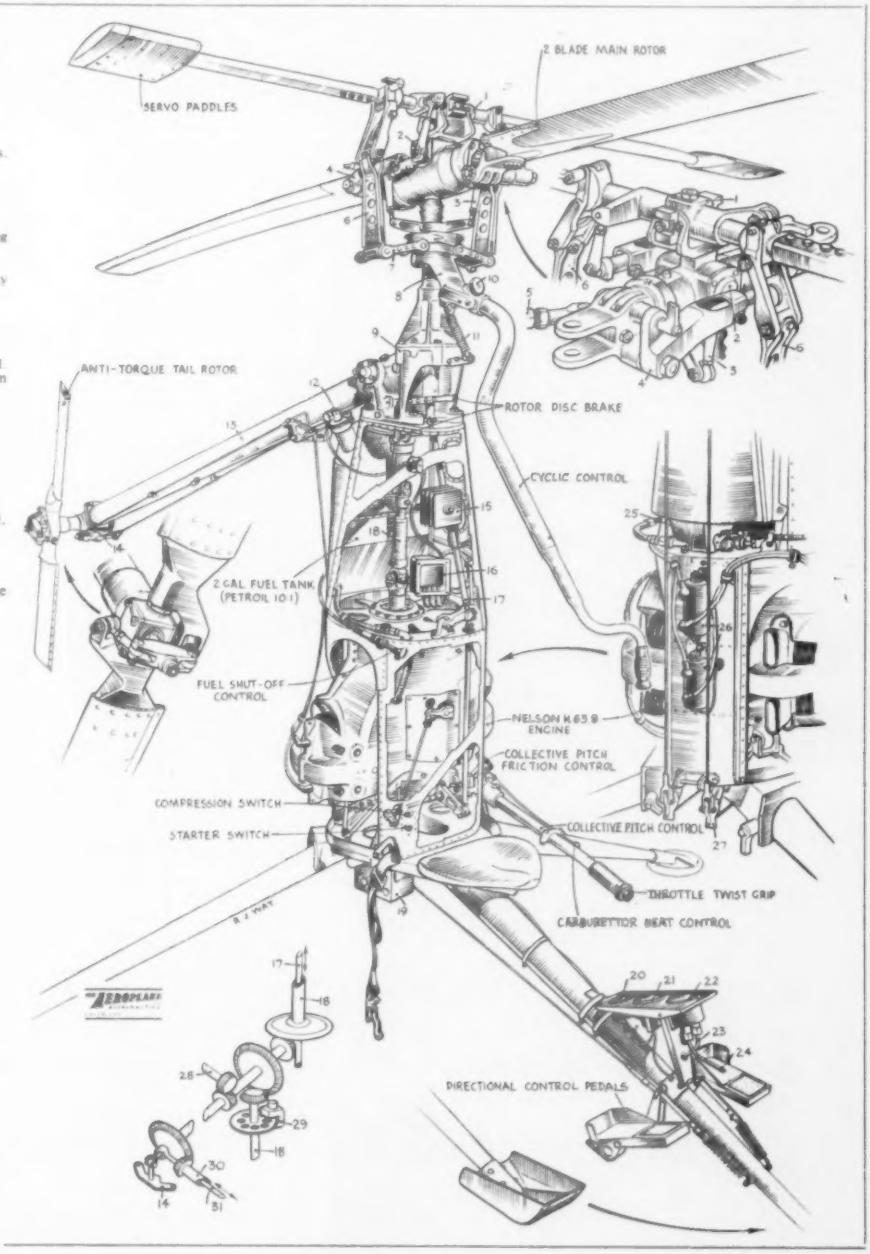
Weights.—Empty, 300 lb.; loaded, 556 lb.

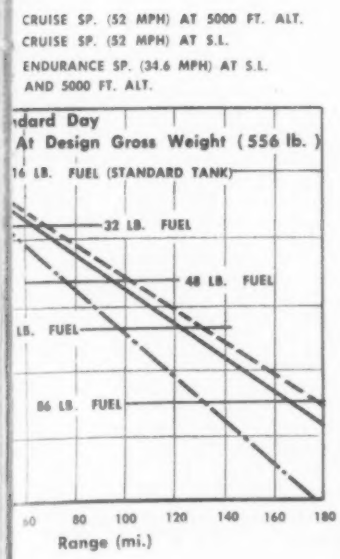
Performance (Figures quoted are for the helicopter when carrying a pilot and pack, total weight 240 lb.).—Vertical rate of climb at sea-level, 330 ft./min.; max. rate of climb at sea-level, 920 ft./min.; service ceiling, 12,000 ft.; max. speed at sea-level, 66 m.p.h.; cruise speed, 49 m.p.h.; hover ceiling out of ground effect, 2,600 ft.; fuel consumption at sea-level, 26.4 lb./hr.

HILLER ROTORCYCLE

Key

1. Rotor hub.
2. Main rotor bearing.
3. Servo-paddle pitch link.
4. Main rotor incidence arms.
5. Drag strut.
6. Pitch control arms.
7. Cyclic control links.
8. Wobbleplate.
9. Transmission housing.
10. Cyclic control trim-spring adjuster.
11. Cyclic control trim spring.
12. Fuel-tank vent and safety chain.
13. Tail boom.
14. Pitch-change crank.
15. Rectifier.
16. Voltage regulator.
17. Collective-pitch control rod.
18. Rotor drive shaft from engine.
19. Batteries.
20. Voltmeter.
21. Tachometer.
22. Airspeed indicator.
23. Static tube.
24. Pitot tube.
25. Fuel-tank sump.
26. Ignition coils.
27. Tail-rotor pitch control, quick-release cables.
28. Tachometer drive.
29. Rotor disc brake.
30. Tail rotor drive.
31. Tail rotor pitch-change control-rod.





Jet Transport for a President

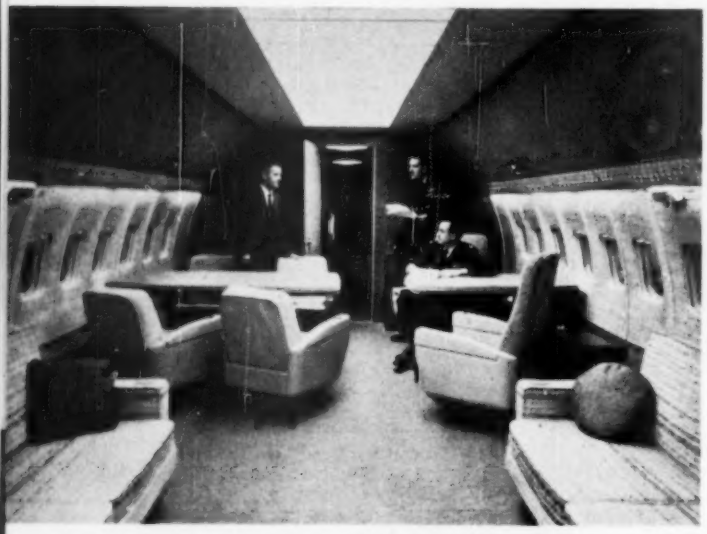
By T. D. Calnan

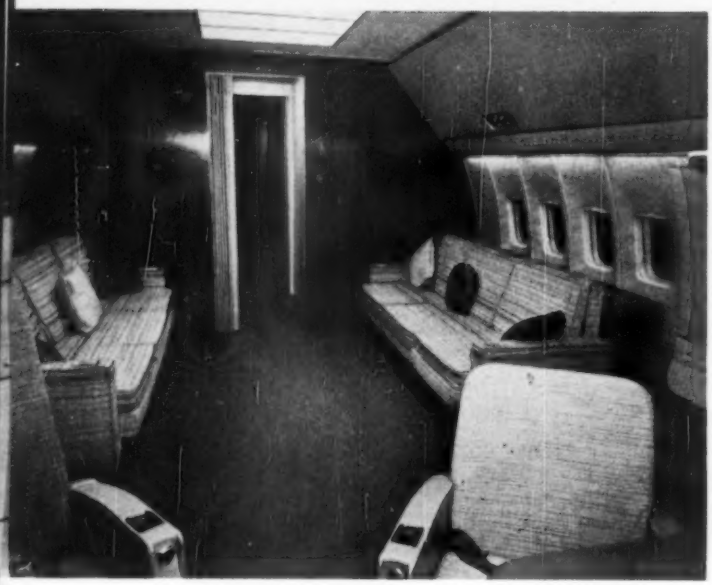
MR. EISENHOWER'S visit to Rome seemed to offer a fleeting but unique opportunity to report on the President's aircraft and the supporting organization which keeps the aircraft serviceable and ensures that the schedule is maintained. In good time before the visit, therefore, I asked formal permission to be allowed to look over the aircraft and talk to the aircraft commander, during the 46-hour stop in Rome.

It was not until after the President had arrived in Rome that I heard that my request had been granted. I was instructed to meet Col. William G. Draper, U.S.A.F., the aircraft commander, at the President's aircraft at Ciampino at 09.30 hrs, on Sunday, December 6, exactly an hour and a half before take-off for Ankara, on the second stage of the tour.

On these occasions, the President's aircraft is probably the best guarded aircraft in the World. At such short notice, I found it impossible to get all the passes necessary to penetrate the ring of Italian police and carabinieri, who were covering all the entrances to the airfield on that Sunday morning.

I therefore had no alternative but to ignore these procedural difficulties and, by taking a very unorthodox route, succeeded in reaching the aircraft exactly at the appointed time. It was fortunate that Col. Draper was equally punctual, as his arrival enabled me to withdraw with dignity from an argument with an Italian plain clothes policeman who was on duty at the foot of the aircraft steps. As it was, I was able to spend a very instructive hour looking round the aircraft and talking to the crew.





Mr. Eisenhower's 707 stateroom looking forward; upholstery is in a light patterned beige.

On journeys of this nature, the President flies in a U.S.A.F. VC 137A, which is a military variant of the Boeing 707/120. Like the latter, it is powered by four Pratt & Whitney JT3 C6s and has an almost identical performance in all respects. On his pre-Western Summit tour, the President covered 23,000 miles in this aircraft and spent a total of 36 hours airborne. It was, therefore, of particular interest to see what was provided for him in this aircraft.

The President's stateroom which, when he is airborne, is the White House, is exactly in the centre section of the aircraft. It is a light and spacious compartment with 11 windows on either side. It is simply and comfortably furnished.

At the forward end of the compartment, on each side, there is a couch which can be transformed into a full-length bed and isolated by curtains from the remainder of the compartment. Aft, on the starboard side, is a conference table surrounded by four swivelling armchairs. Opposite on the port side is a smaller table with two armchairs. It is at this table, in the forward facing chair, that the President usually sits, even for take-off. In this position he has at his left hand a white telephone set via which, by means of single-sideband radio, he can talk to practically anywhere in the World.

Above, the telephone set at the side of the swivel armchair which the President usually occupies in his special Boeing 707; this is on the port side at the rear of the stateroom. Left, the stateroom looking aft.

Immediately forward of the stateroom, separated by a bulkhead and door, is the President's dressing room (port) and lavatory (starboard).

From this point forward, the aircraft belongs to the crew. Aft of the flight deck, on the starboard side, is the communications centre and radio operator's position. The radio operator, on these trips, is a very busy man with a big responsibility. His equipment, which is special to the three VC 137As maintained by the U.S.A.F. for the President, consists of HF, VHF and UHF transmitters and receivers, radio telephone and radio teletype.

Just aft of the communications centre is the crew's galley and aft again is the crew's rest compartment containing on each side of the central gangway, four reclining seats and a table.

The crew of the aircraft is 10 strong. Besides Col. Draper there are two other pilots, one navigator, one radio operator, two flight engineers and three stewards. Most of this crew, including the aircraft commander, have been with Mr. Eisenhower since the days when he was Supreme Allied Commander Europe.

The main passenger compartment, aft of the President's stateroom, seats 28 passengers. On a major trip, such as the recent one, there would be a full complement of passengers, made up of the President's staff of experts from the White House, the security men who are responsible for his safety, his doctor and

(*Continued on page 43*)

Aircraft serve the world...

Aircraft play an important part in New Zealand's agriculture. The aircraft, photographed near Matamata, is top-dressing farm lands with superphosphate. The photograph is by courtesy of the High Commissioner for New Zealand.

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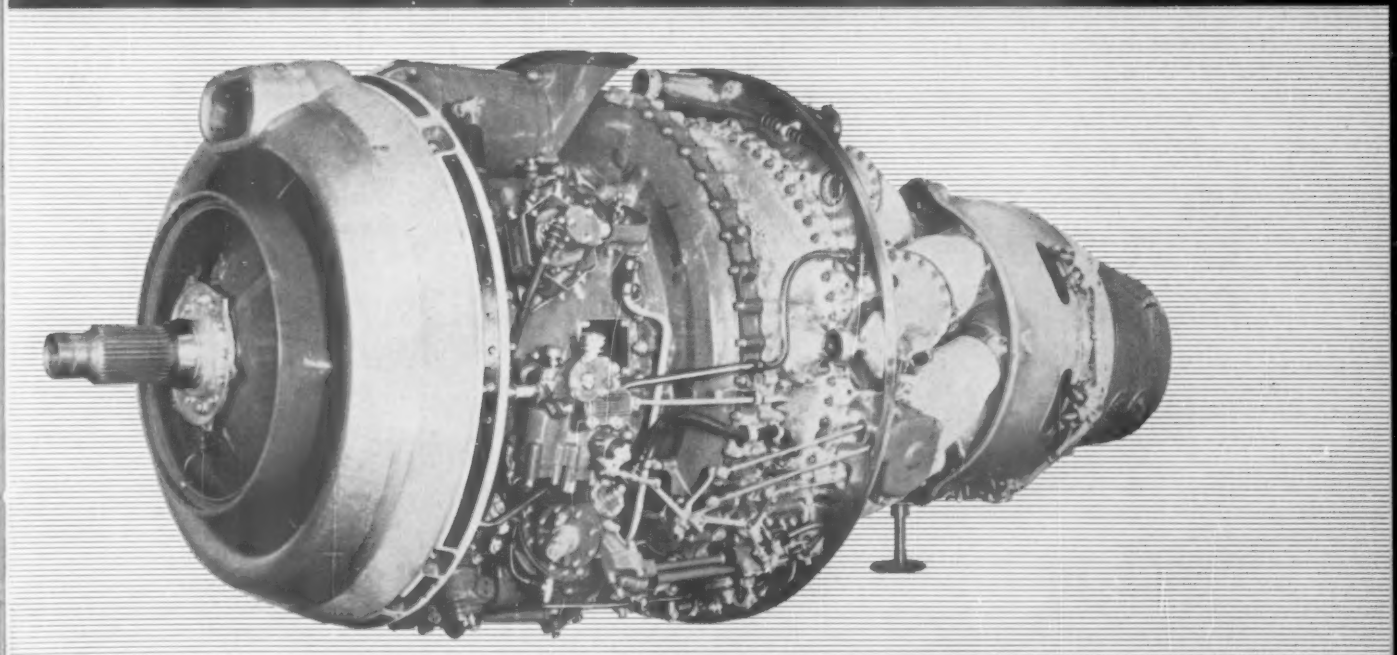

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The aft cabin of the U.S.A.F.'s Presidential 707 has 14 double reclining seats; two tables are installed between the front eight seats.

(*Continued from page 42*)

the aircraft guards. These last-named have the sole duty of guarding the President's aircraft while it is on the ground. Their number varies according to the requirements of any particular trip.

Access to the passenger compartment is by rear doors on the port and starboard sides of the aircraft. The President uses the forward entrance on the port side immediately opposite the radio operator's station.

Logistic support for the President's aircraft is provided by four C-130s, two of which come from Tactical Air Command and two from United States Air Forces Europe. These aircraft carry the maintenance teams and every foreseeable piece of equipment and spare part which might be needed anywhere along the route, including starters, compressed air, oil and a complete spare engine.

In addition, a second VC 137A follows the same itinerary as the President as a reserve aircraft. The old "Colombine," a VC 121 (Constellation), which was the President's aircraft before the Boeing, also accompanies the party. It is another reserve aircraft and might be required should the President decide to fly to an airfield with insufficient runway length for the Boeing.

The C-130s follow a leapfrogging schedule, some ahead of the President, preparing for his arrival, some behind, clearing up.

The whole route flown by the President was surveyed by Col. Draper in a VC 137A about a month before the start of the trip. The only difficult point in the whole itinerary was Kabul, 6,000 ft. above sea level, where the airfield, built by the Russians, is surrounded by high mountains and has no instrument landing facilities. To safeguard the President, arrangements were made for a U.S.A.F. C-47, airborne in the Kabul area, to transmit first-hand weather reports to the President's aircraft as it was on route from Karachi. Had the weather closed in, the plan was to cut out Kabul and proceed to New Delhi, hoping to put Kabul back into the itinerary on the return flight.

The President flew into Ciampino direct from Goose Bay. The flight plan was for a step climb to 35,000 ft., a cruising speed of Mach .82 and a flight time of 6 hr. 15 min. Leaving Rome, the flight plan was for a 2½-hr. flight at 30,000 ft. to Ankara. Cabin pressure in the aircraft is sea level up to 22,500 ft., after which the cabin altitude increases by 100 ft. for every 1,000 ft. of actual altitude.

Tyres for the Boeing 707

BRITISH-MADE tyres—produced by the Firestone company at Brentford—are being fitted to Boeing 707s operated by several airlines. The following notes give an indication of the considerations involved in developing tyres for a heavy aircraft of this type which has comparatively high landing and take-off speeds.

Right from the inception of the Boeing 707 it was realized that the question of tyres would need a great deal of thought. Heavy loading and high take-off and landing speeds call for very serious consideration in terms of safety of the machine and its passengers.

In this case each main wheel tyre, of which there are eight on each machine, has to be designed to carry a normal static load of approximately 16 tons at a deflection in the region of 33% of tyre-to-rim height, calling for an inflation pressure of 160 p.s.i. At take-off speeds in the region of 150 knots the periphery speed of the tyre is very great and this, plus the flexing which takes place during normal taxiing runs and the dynamic load imposed upon the tyre on landing, all mean that a vast amount of responsibility is thrown upon the tyre.

To meet this problem with any degree of confidence needs large development resources and a vast amount of service experience. Here, the Firestone company in England has a great advantage because they have been able to draw upon the wide experience of the American Firestone company. The latter have spent some years in developing this kind of tyre, with the result that both the design and the performance were given unqualified approval, having successfully passed the most stringent qualification tests.

In America, Firestone have a high-speed dynamometer, on which Boeing tyres have successfully accomplished 50 simulated 200-m.p.h. landings followed by 100 98-m.p.h. landings in accordance with dynamic tests recommended by the Tire and Rim Association of America.

The tyre sizes of the Boeing 707 are 39 x 13 for the two nose wheels and 46 x 16 for the eight main wheels, all of them of tubeless construction. The former has twin beads and the latter has triple beads. In each case, the chafer covering the bead is of monofilament nylon, as in the case of all other Firestone tubeless tyres, to prevent capillary action of the air and so assist in the maintenance of pressure.

To cope with the needs of the various operating conditions which any of the three versions of the aircraft may have to meet, there are three different ply rating constructions in each of the two tyre sizes. They all have a high-speed ribbed tread which combines the highest factors of anti-skid, streamlining and good wear properties. The tread contour is a little flatter than in many tyres of a similar kind, with the object of spreading the wear.

The standard form of Firestone tyre for the Boeing has a skid depth of only about 0.3 in. because the high periphery speeds involved cause such great stresses on the tyre as to lead to a tendency to tear the tread from the carcass. There is another construction of Firestone tyre available for the Boeing if required. This has a special fabric-reinforced tread and is obviously heavier and considerably more expensive but it does allow an increased skid depth of 0.4 in., giving more landings per tyre.

Above, the high-speed dynamometer used for testing Firestone tyres in America. Right, each of the eight wheels of the Boeing 707's main undercarriage carries a normal static load of 16 tons.

The Fighting Services

R.A.F. Promotions

IN the half-yearly promotion list which took effect on January 1, the Air Ministry announced 30 air rank promotions.

Air Vice-Marshal H. P. Fraser, U.K. Representative on the Permanent Military Deputies Group, CENTO; A.V.M. Sir Walter Cheshire, A.O.C., R.A.F. Malta; A.V.M. H. D. McGregor, A.O.C.-in-C., Fighter Command; and A.V.M. Sir William L. M. MacDonald, C.-in.-C., Middle East Air Force, have been promoted to the rank of Air Marshal.

Air Commodore P. D. Holder, A.O.C., R.A.F. Hong Kong; Air Cdre. A. Foord-Kelcey, A.O.C., No. 11 Group; Air Cdre. C. Scragg, A.O.C., No. 23 Group; Air Cdre. H. J. Maguire, A.O.C., No. 13 Group; Air Cdre. R. N. Bateson, Assistant Chief of the Air Staff (Operational Requirements); Air Cdre. P. G. Wykeham, A.O.C., No. 38 Group; Air Cdre. H. Ford, S.T.S.O., Flying Training Command; and Air Cdre. T. U. C. Shirley, S.T.S.O., Fighter Command, have all been promoted to the rank of Air Vice-Marshal.

Group Captains W. S. Gardner, D. F. Spotswood, S. W. R. Hughes, D. C. McKinley, A. R. D. MacDonell, J. B. Russell, P. E. Warcup, F. W. Thompson, W. I. C. Inness, D. M. Strong, G. R. Magill, H. J. Hickey, F. O. S. Dobell, W. D. Disbrey, J. W. Bayley, E. M. T. Howell, W. MacI. King and L. C. Dennis, have been promoted to the rank of Air Commodore.

Recognition Competition

ORGANIZED by the Aircraft Recognition Society, the 13th all-England annual aircraft recognition competition will be held on Saturday, January 23, at the Royal Commonwealth Society, Craven Street, Strand, London.

The competition is open to teams of three members representing various societies and Service units, including the Royal Observer Corps and Air Training Corps. Independent umpire for the competition will be Air Cdre. G. J. C. Paul, Secretary-General of the Air League.

Prizes to be contested for include the Silver Heracles Trophy for the highest-scoring A.T.C. or Combined Cadet Force team; the *Air Pictorial* Trophy for the highest-scoring A.T.C. or C.C.F. individual competitor; the Bristol Bloodhound Trophy for the highest-scoring team from British or overseas forces; and the Royal Netherlands Fokker D.21 Trophy for the highest-scoring individual among British and overseas forces' teams.

New Helicopter Squadron

FOLLOWING the disbandment of the Joint Experimental Helicopter Unit at Middle Wallop at the end of last year and the transfer of its Whirlwinds and Sycamores to Transport Command, a new R.A.F. helicopter squadron has been formed. This is No. 225 Squadron under the command of Sqn. Ldr. A. Twigg and based at Andover.

First formed towards the end of the 1914-18 War, No. 225 Squadron was disbanded at Otranto, Italy, in 1919, and came into being again at Odiham in October, 1939, as an Army co-operation squadron.

During the first months of the Second World War the Squadron was engaged in coastal reconnaissance and air/sea rescue work, flying from airfields in the south of England. In August, 1941, it went to Thruxton and was equipped with Hurricanes. It later received Mustangs, but on moving to Macmerry in August, 1942, reverted to Hurricanes. A few months later the Squadron went to Maison Blanche, near Algiers, to operate in support of 5 Corps, giving tactical reconnaissance cover over the First Army front. While in North Africa the Squadron, flying Spitfires, was engaged in tactical reconnaissance, artillery reconnaissance and photography, and in fighter-bomber operations supporting 5 Corps and the French 19 Corps.

The Squadron moved to Arjana, then to Tunis, in May, 1943, while a detachment at Korba made sorties over Pantellaria and Lampedusa. In August the Squadron operated from Francesco, Sicily, coming within No. 285 Wing, Desert Air Force, in preparation for the Salerno landings. They moved across Italy with the Allied advance, covered the Anzio landings in June, 1944, and then flew from Corsica before taking part in the invasion of Southern France. In September, 1944, No. 225 Squadron went back to Italy, and after the War moved to Austria to become part of 2nd T.A.F. at Klagenfurt. In July, 1946, it returned once more to Italy and was disbanded at Campoformido in January, 1947.

NATO COMMANDER.—Vice-Admiral C. L. G. Evans, C.B., C.B.E., D.S.O., D.S.C., R.N., right, succeeds Vice-Admiral W. J. Woods as NATO Deputy Supreme Allied Commander Atlantic next April. Flag Officer Aircraft Carriers since January of last year, Vice-Admiral Evans will also be the NATO Commander of Striking Group Two.

More Service News

No. 56 Squadron Reunion.—The reunion dinner for officers of No. 56 (F) Squadron, originally scheduled for January 16, has now been postponed until April 9. Further details may be obtained from the Squadron Adjutant, R.A.F. Stradishall, Newmarket, Suffolk.

Anniversary Concert.—This year the annual concert given by the Halle Orchestra and the Central Band of the R.A.F. to commemorate the formation of the Service will be held at the Royal Festival Hall on Wednesday, April 6. As usual, all proceeds are to be given to the R.A.F. Benevolent Fund.

"Ark Royal" Recommissioned.—The carrier "Ark Royal" was recommissioned at Devonport on December 28 following a 14-month refit. Commanded by Capt. P. J. Hill-Norton, R.N., she will be operating Scimitars, Skyraiders, Sea Vixens and Whirlwinds.

No. 2 Squadron Reunion.—A No. 2 Squadron reunion dinner is to be held at the Victory Ex-Services Club, London, on March 18. Send remittance, 21s. 6d., for ticket and further details to Flt. Lt. D. C. Gathercole, Officers' Mess, R.A.F. Chivenor, Barnstaple, Devon.

WET DESCENTS.—Members of Operation "Changi Splash" standing beside a F.E.A.F. Valetta before their parachute jump into the sea off Changi on December 15. Extreme left is Flt. Lt. S. Roe of the F.E.A.F. Survival and Parachute School, who acted as "drifter." Next to him is Air Vice-Marshal R. A. Ramsay Rae, A.O.C., No. 224 Group, who was making his first jump ever.

Astronautics and Missiles

Solid Propellents in Spaceflight

THE fast development of solid-propellent rockets in recent years has brought us to the stage where not only can small, compact, ballistic missiles be produced but also rockets capable of both orbital and "escape" missions. In the former category are Polaris and Minuteman. An example of an all-solid, multi-stage, orbital rocket is the Chance-Vought Scout which is capable of launching satellite payloads of 150 lb.

There are good reasons for the current enthusiasm for "solids," as Mr. H. L. Thackwell, Jr., of the Grand Central Rocket Company, has pointed out in an interesting paper* which forms the substance of this article.

In comparison with liquid-propellent rockets, the solid variety offer greater simplicity and reliability; they have a shorter development time, are inherently adaptable to spin-stabilization, have relatively low development cost, and high performance is obtainable from relatively small units. An illustration of this last is that the solid third-stage rocket used in the Vanguard satellite launching vehicle contributed more than half of the required 25,000 ft./sec. incremental orbital velocity.

The design of the Vanguard third stage represented a challenge to the two manufacturers concerned, Grand Central and the Allegeny Ballistics Laboratory, who were awarded competitive contracts to develop two similar, but distinctive, rocket motors. The big problem was that the burn-out velocity specified for Vanguard's top stage was considerably greater than had hitherto been achieved, or indeed had even been considered possible.

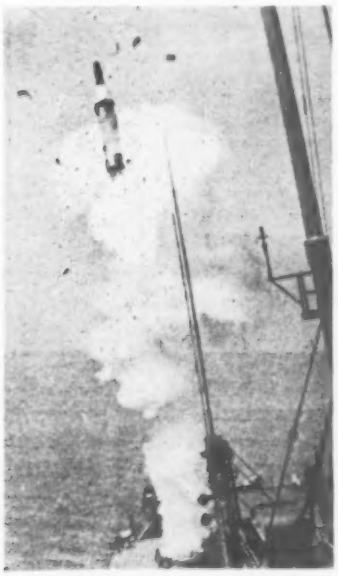
However, by taking advantage of the fact that the specific impulse of a rocket motor operating in a vacuum is essentially independent of the combustion pressure, it was found possible to use a very low pressure which, in turn, enabled the construction of an unusually light form of combustion chamber. This lightweight chamber, together with the star-shaped, case-bonded propellent grain of high volumetric efficiency, resulted in a conservatively designed motor which was developed in the brief span of nine months.

The success and demonstrated reliability of this and similar solid-propellent motors led the National Aeronautics and Space Administration in mid-1959 to commence development of the Scout, a four-stage, all-solid, vehicle intended for low-cost satellite and space-probe missions. Each Scout is expected to cost about $500,000 and NASA intend using it as a sounding rocket to carry a 50-lb. payload to a 7,000-mile altitude, to put 150-lb. payloads into 300-mile orbits, or 100-lb. satellites into 500-mile orbits. It is, of course, the same rocket that is being offered to other countries for launching scientific instruments and it has already been announced that Britain has arranged to use it in 1961.

Scout's development has been facilitated because improved models of existing solid-propellent motors are being used for the first, second and fourth stages, and the third-stage motor will be a simple scaled-up version of the existing fourth-stage unit. In fact, a three-stage version should be test-launched from Wallops Island, Virginia, within the next few months and firing of the fully fledged four-stage vehicle should follow by mid-summer. This unusually short development time should enable the Scout to be used at an early date for many of the vertical trajectory and orbiting missions which at present require highly complex and expensive liquid-propellent vehicles.

The almost "impossible" specification for Vanguard's third stage called for a solid rocket, launched parallel with the Earth's surface at 300 miles, to contribute more than half of the incremental orbital velocity.

* "The Application of Solid Propellents to Space Flight Vehicles."



A modern example of a high-performance military all-solid step-rocket is the Polaris, seen here igniting over the deck of the USS "Observation Island" off Cape Canaveral on August 27, 1959. Housed in a launching tube which protrudes from the deck, the missile is shot out by compressed-air. Objects around Polaris are launching shoes, used to centre the missile in the tube during firing.

Reducing Costs

Indeed, a good reason why solid propellents have a big future in space exploration is their comparatively low cost. Those who must, in the end, pay for space activities—the taxpayers—says Mr. Thackwell, are becoming increasingly aware of the fact that this astronautical business is an inherently costly activity, and the reasons why solid-propellent rockets are the least expensive form of chemical rocket propulsion are given as follows:—

(1) The superior reliability of the solid propellent means more successful missions completed per dollar.

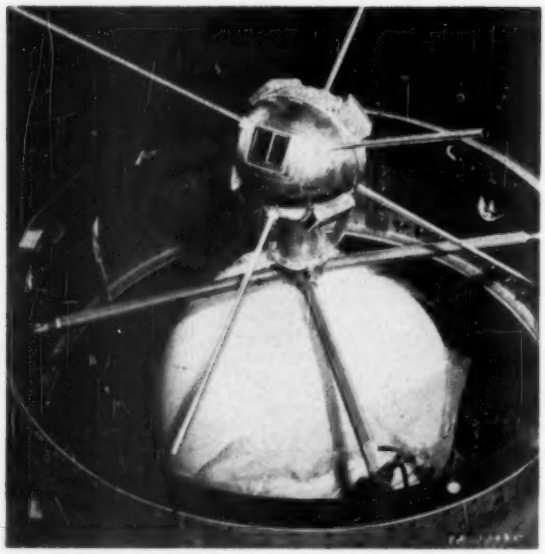
(2) Because of their basic simplicity, solid rockets can be developed in a comparatively short time with corresponding minimum labour and facilities costs.

(3) The inert parts of the solid rocket are not complex and, therefore, are inexpensive in comparison with liquid-rocket parts (no pumps, valves, and similar costly hardware items are required for solid rockets).

(4) The field handling and pre-launch test operations for solid rockets are an order of magnitude cheaper than those for present liquid rockets because the need for elaborate ground handling equipment and expensive "stand-by" personnel is eliminated.

(5) The cost of the propellent itself (loaded into the rocket) is comparable to that for liquid propellents when one realistically considers the cost of special equipment and highly trained personnel required for fuelling (and refuelling) some of our present liquid rockets.

One might conclude from the foregoing that if one were to be given the task of developing an *entirely new* multi-stage space rocket (using no existing components) to deliver a particular



The 6.4-in. 3¼-lb. test satellite in place on the third-stage solid rocket, itself housed inside the second stage on a "spin-up" platform designed to impart stability to the final stage after separation.

payload into an Earth orbit, to the Moon, or to an escape velocity for deep space missions—with the further stipulation that this job be done in the most reliable manner, with the least amount of money, and in the shortest possible time—one would unquestionably choose solid propellents. But, one may ask, how do solid-propellent rockets compare on the basis of overall performance? Does not the recognized high specific impulse attainable by some liquid propellents, and the high ratios of propellent weight to gross mass in existing large liquid motors, tend to tip the scales in favour of liquids?

In answering this question realistically, one must think in terms of very large rockets having thrusts at least three times that of Atlas. Here, as Mr. K. J. Bossart of Convair has stated, the problems of controlling liquid propellent sloshing and minimizing ullage will be very severe indeed, and will most certainly cause a decrease in attainable motor mass ratio. Also, when such liquid rockets as the Atlas are scaled up to larger sizes, the turbo-pump weight required to maintain sufficient thrust for take-off increases faster than the propellent weight, which also will cause an appreciable reduction in the motor mass ratio.

Conversely, solid propellents have no sloshing or ullage difficulties, and being "self-pumping," they are not troubled by turbo-pump weight problems. Also, the great density of the solid propellents (from 50% to 70% higher than most liquid propellents) permits the use of considerably smaller tanks for a given propellent weight. This, plus the fact that solids can be effectively utilized at very low combustion pressures, should allow large solid-propellent rocket motors to achieve mass ratios as great as, or even superior to, those attainable with comparable liquid systems.

Concerning propellent specific impulse, it is true that the common liquid propellents of today have specific impulse values of from 8% to 20% better than most solid propellents now in use. However, the solid rocket makes up for this disadvantage in that it can be readily designed, with no losses in motor mass ratio, to operate at the relatively high thrust-to-weight ratios necessary to minimize the velocity increment lost to gravity (i.e. $g \times t$ losses) during boost stage vertical flight.

On the other hand, most large liquid rockets are at a serious disadvantage in this respect because they must experience the excessively long burning times and attendant exorbitant gravity losses caused by their inherently low thrust-to-weight ratios. To visualize how large these velocity losses due to gravity can be, suppose that one was forced, because of turbo-pump weight problems, to have a liquid booster burning time of 120 sec. instead of a hypothetical value of approximately 45 sec.

For a three-stage satellite vehicle, the burn-out velocity of the first stage might be 8,000 ft./sec.; thus one would effectively gain, assuming vertical flight during boost, a 30% potential increase in velocity by using the faster-burning, higher-thrust, solid-propellent motor. This reduction of the gravity deceleration effect would then more than cancel the advantage of the liquid unit's higher specific impulse.

Conversely, by using slow-burning solid propellents, long burning times can be achieved for intermediate stages where the flight path is more horizontal than vertical. Thus, where it may be desired to maintain thrust for an appreciable period in order to minimize the time required to reach a desired orbiting altitude, a large saving in gravity losses can again be achieved with such solid rockets by making a reduction in the relatively long period normally spent in upward coasting flight.

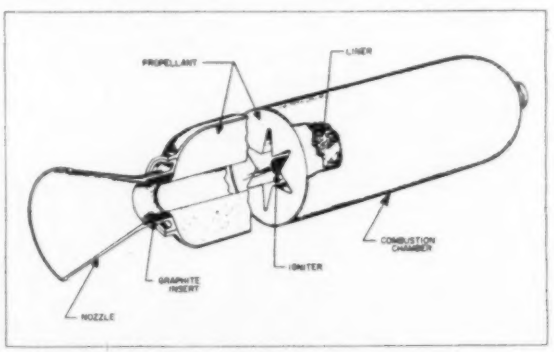
Finally, solid-propellent rockets, because of their smaller size (as a result of their greater propellent density) and basic simplicity, are inherently easier and lighter to stage and cluster than comparable liquid rockets. Here, the superior reliability of the solid rocket will really "pay off" because the reliability of the overall propulsion system is the product of the individual motor reliabilities.

For a hypothetical example, a four-stage solid rocket with an individual motor reliability of 0.99 would have an overall reliability of at least 0.96, as compared with only 0.72 for a three-stage liquid rocket with an individual motor reliability of 0.90. Moreover, if the two lower stages of each type vehicle were composed of clusters of three separate motors, the reliability of the solid vehicle would still be about 0.93, whereas the liquid vehicle would then be only 47% reliable (i.e., at least one out of every two liquid vehicles would fail).

New Vehicle Concepts

To illustrate the potential of solid propellents for reliable, low-cost space flight, Grand Central Rocket Co. has made preliminary design calculations for a simple three-stage, all-solid-propellent vehicle called the Envoy; when ground-launched, it could send a 50-lb. payload to the Moon or place a 230-lb. payload into a 300-mile circular orbit. This vehicle would weigh only 17,000 lb. and be only 37.8 ft. high. Moreover, after development, it is anticipated that the three-stage Envoy would cost considerably less than the $500,000 quoted for the Scout or $1,000,000 for a single Thor liquid booster.

It is intended that the same type of simple control and guidance system as the Scout employs would be used for the Envoy—fins and jet vanes for the first stage, fixed hydrogen peroxide jets for the second stages, and the third stage spin-stabilized. The guidance equipment and the solid-propellent spin rockets for the final stage would be carried by the second stage in a forward compartment in a manner similar to that employed for the Scout.



A typical solid-propellent motor employing an internal-burning, case-bonded, star-shaped grain.

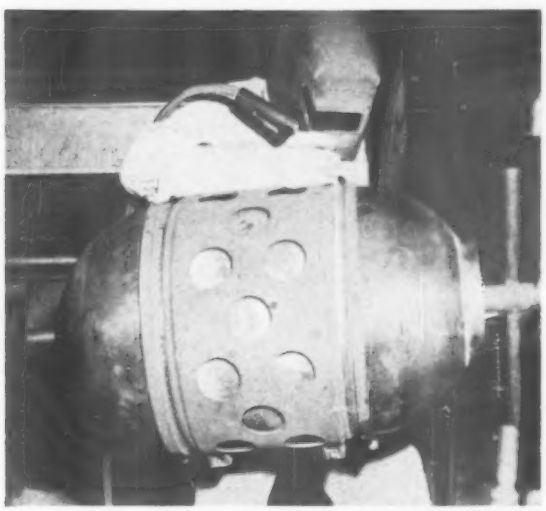
The motors of all three stages would employ conventional case-bonded, internal burning, star-type grains of high volumetric efficiency similar to the grain design used for the GCR third-stage Vanguard motors. The 8,026-lb. motor of the second stage would be a direct scale-up of the 401-lb. third-stage motor, with both motors operating at the relatively low combustion pressure of 350 p.s.i. and having nozzle expansion ratios of about 25. The 8,138-lb. first-stage motor would be identical to that of the second stage except that it would operate at 700 p.s.i. and, therefore, would employ a nozzle with a smaller throat and have a greater combustion chamber wall thickness.

Also, because the first stage would be operating for some time

in the dense part of the atmosphere, its nozzle expansion ratio would be reduced to a value of approximately 10 to allow optimum thrust efficiency. With careful attention being paid to the design and testing of the inert parts, and with high strength-to-weight ratio materials used in the construction, it is believed that a motor mass ratio of about 0.927 could be achieved for the first stage, and correspondingly higher ratios of approximately 0.94 attained for the lower pressure second- and third-stage motors.

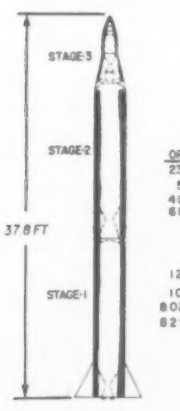
Propellent specific impulse values of about 284 have been assumed for the upper two high-altitude stages, with a corresponding reduction to an average value of 264 for the first stage which must operate within the atmosphere. These particular specific impulse values correspond to 250 at 1,000 p.s.i. pressure at optimum expansion ratio at sea level, a commonly published value for high-energy ammonium perchlorate based solid propellents.

Despite being of smaller size and only half the weight of the Scout vehicle the Envoy would have equal, or greater, performance because it could have newer type motors specially designed and optimized for its specific task, rather than being comprised of existing motors designed for other purposes. Also, being a completely new design, the Envoy would benefit from the use of optimum staging principles.



The lightweight case for Vanguard's final stage motor was made of 0.025-in. thick Type 410 stainless steel, fabricated by Heliarc welding. Dimensions of the chamber were 36-in. long by 18-in. diameter, and both ends were hemispherical, one end supporting the flared rocket nozzle and the other the "pin" for attachment of the satellite.

For example, for a minimum weight rocket with a certain desired performance and payload, the upper stages should be made much larger than indicated by classical staging theory because of their inherently higher motor mass ratios and specific impulse values. In fact, for the Envoy gross weight and required performance, the arrangement chosen (which enables the first-stage motor to utilize the same case dimensions and propellent grain as the thinner wall, lower pressure, second-stage motor) is a near optimum configuration.



STAGE 3

ORBIT		ESCAPE
230	PAYLOAD	52
50	STRUCTURE	50
401	MOTOR	401
681	TOTAL	503

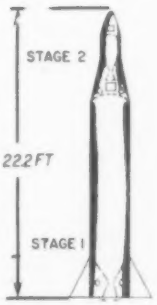
STAGE 2

125	CONTROL SPIN-UP	125
100	STRUCTURE	100
8026	MOTOR	8026
8251	TOTAL	8251

STAGE 1

ORBIT		ESCAPE
40	CONTROL	40
200	STRUCTURE	200
8138	MOTOR	8138
8378	TOTAL	8378
17310	GROSS	17132

Three-stage, all-solid, Envoy rocket proposed by the Grand Central Rocket Co., for sending small instrument payloads into space.



STAGE 2

ORBIT		ESCAPE
60	PAYLOAD	5
50	STRUCTURE	50
401	MOTOR	401
511	TOTAL	456

STAGE 1

100	GUIDANCE SPIN-UP	100
70	CONTROL	70
200	STRUCTURE	200
8138	MOTOR	8138
8508	TOTAL	8508
9019	GROSS	8964

The two-stage Envoy "escape" vehicle.

Air Launching?

Would the Envoy be useful only as a ground-launched vehicle? This question, says Mr. Thackwell, brings to mind a pleasant occasion a year ago in San Diego when he first met that distinguished scientist and World authority on jet propulsion, Dr. Theodore von Kàrmàn, at a technical meeting on space-flight problems.

In answer to the question as to what he believed would be the chief means of space propulsion during the next decade, Dr. von Kàrmàn replied that solid-propellent space vehicles would be most commonly used. Furthermore, he believed that such solid-propellent space-flight vehicles would be launched at high altitudes from jet aircraft which could be used for many separate launchings, rather than employ very large expensive boosters which would not be easily recoverable.

In view of Dr. von Kàrmàn's remarks on this important subject, Mr. Thackwell considers what performance the 17,000-lb. three-stage Envoy would have when launched at 50,000 ft. altitude from a jet aircraft flying at 600 m.p.h.

As the Envoy would be operating entirely at high altitude, it would be best to employ another second-stage motor for the booster in place of the less efficient first-stage motor of the ground-launched version. The use of this higher performance booster, together with the initial 600 m.p.h. boost velocity and the somewhat lower drag and gravity losses permitted by the high-altitude launch, would enable the air-launched Envoy to escape with at least a 175-lb. payload, or, alternatively, to place 430 lb. of useful payload into a 300-mile orbit.

Assuming a total cost of $300,000 per flight, this amounts to less than $700 for each pound of payload put into orbit. This is a very low cost compared to that currently being spent in the United States for launching payloads with liquid-propellent vehicles.

However, there are many interesting escape and satellite missions for which much smaller (and, therefore, less expensive) payloads would be entirely adequate. At Grand Central there is the "stripped-down" economy model, or the two-stage Envoy. This simplified two-stage ground-launched version of the Envoy would be identical to three-stage, ground-launched vehicles, except that the second-stage motor would be omitted. This model, which would be only 22.2 ft. long, is expected to escape with a small 5-lb. payload and permit a 60-lb. payload to be put into a 300-mile orbit. Similarly, the two-stage, air-launched Envoy (with one of the two second-stage motors omitted) would be able to orbit a 140-lb. load, or to escape with a 25-lb. payload.

Here then, in the field of low-cost space probes, is an area where solid-propellent rockets are in the ascendancy. In a very short time, these solid space rockets will prove to be sufficiently inexpensive to be within the budget of any nation wishing to pursue its own space programme.

High-energy Rocket Propulsion

A BIG future for high-energy rocket systems is foreshadowed by the development in the United States of the first liquid oxygen/liquid hydrogen rocket engine.

Developed by Pratt & Whitney at the company's research and development centre at West Palm Beach, Florida, the XLR-115 prototype engine has already been test run for several minutes at a time, starting and operating under simulated space conditions. In these tests, the power unit has achieved its rated thrust of 15,000 lb., and produced a specific impulse more than 30% greater than standard engines running on liquid oxygen/RP-1 (kerosene).

Pratt & Whitney estimate that the energy-yield of liquid hydrogen promises substantial payload increases for missiles and space-vehicles, and that the substitution of LOX-hydrogen powered rocket stages for LOX-kerosene stages can multiply the payload as much as 3½ times.

Some of the examples they give, based on the XLR-115 engine, are as follows:—

(1) A hydrogen second stage added to a current ICBM such as the Convair Atlas will more than double the payload, or increase the range. (2) The payload of a current two-stage ICBM, such as the Martin Titan, would be doubled if the second stage was converted to hydrogen. (3) Three hydrogen stages will perform the same function as two conventional LOX-kerosene and two hydrogen stages, thereby eliminating a stage.

In a space application, the use of a hydrogen propulsion unit offers attractive advantages. For example, to place an artificial satellite in a 24-hr. orbit at a height of 22,300 miles (so that it remains "fixed" in the sky relative to a point on the Earth's surface) the use of four hydrogen stages would yield a payload more than 3½ times that possible with four LOX-kerosene stages.

Hydrogen Cycle

Not only is the XLR-115 the first LOX-hydrogen engine to be developed (at least, outside Russia), it is also probably the first rocket engine to utilize what is called the "bootstrap" cycle. Most rocket engines require that a part of the rocket's propellent is by-passed and burned in a separate gas-generator to operate turbo-pumps which force the propellents into the thrust chamber.

In the new Pratt & Whitney engine, the pumps are driven instead by the expansion of the hydrogen used for cooling the combustion chamber and nozzle which are jacketed for this purpose. The operating cycle is as follows: Liquid hydrogen enters the cooling jacket at −423°F. (This compares with the combustion temperature of about 5,500°F.) In the cooling jacket, the hydrogen absorbs heat and is converted to gas, which then expands into a turbine to drive the pumps. Thus the fuel performs two functions before it is burned. It pumps propellents into the engine and it cools the thrust chamber, without any part being burned before it produces useful thrust.

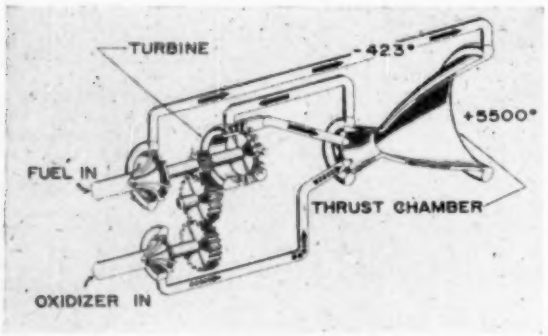


Diagram illustrating the operating cycle of the Pratt & Whitney XLR-115 LOX/liquid hydrogen rocket engine. The thrust chamber is regeneratively cooled by passing liquid hydrogen through a jacket surrounding the combustion cnamber and nozzle; expanded into gas by the heat of the combustion chamber, the hydrogen serves to drive the turbo-pumps before injection into the thrust chamber for burning with liquid oxygen. The starting method has not been revealed.

Three-quarter rear view of the Pratt & Whitney XLR-115 engine showing the propellent pumps, turbine and feed lines.

Development Programme

Development of the XLR-115 was initiated by the U.S. Air Force and is now being directed by the National Aeronautics and Space Administration. In the process, Pratt & Whitney and its parent company, United Aircraft Corporation, have acquired considerable experience in the handling of large quantities of the new fuel, and several million gallons of liquid hydrogen have been used to date. Engine tests have been conducted on a group of four static stands at the Florida facility designed to test engines of up to 300,000 lb. s.t.

Two of the XLR-115 engines mounted side by side will power the second stage of the Centaur space-vehicle, which will use as its initial stage an Atlas-D. These engines are also scheduled for use in an upper stage of the giant Saturn booster, designed to lift payloads of 35,000 lb. into a 300-mile orbit, or project 12,000 lb. on deep space missions.

It is perhaps worth noting that a LOX-hydrogen second stage adapted to our own de Havilland Propellers Blue Streak LRBM would enable us to engage in the most advanced research, within our own industries—affecting the commercial development of radio and television repeater satellites, to give one pertinent example. It would also give us the opportunity to pursue the development of boost-gliders and orbital vehicles of man-carrying capacity, in the new era of flight in which the Americans have already broken ground with the NASA/U.S.A.F. Dyna-Soar project.

General Aviation News

OSTIV CONGRESS, 1960.—This year's OSTIV congress covering sailplaning affairs will be held in Cologne in June, 1960. Anyone wishing to present papers of a technical nature during this congress on sailplane aerodynamics, design, airworthiness, equipment, training, maintenance or instruments should contact Col. Floyd J. Sweet, Hamburgstrasse 22, Wiesbade-Aukamm, Germany. Summaries of promised papers should be sent to Col. Sweet so that there may be sufficient time for review and acceptance for the programme.

MIDGET "EYE."—A miniature "one-shot" camera not much larger than a cotton reel is being mounted in guided missiles at Woomera to record details of target interception. It weighs 8 oz., is 1½ in. in diameter and 1¾ in. long, is made of steel and is virtually indestructible. An ultra wide angle lens gives a field of view of 180° so that two cameras mounted back to back will provide coverage through 360°. The camera is made by Fairey's Australian company.

SOVIET SPACE FILM.—A new Soviet film, "Earth-Moon," has recently been completed at the Moscow Popular Science Film Studio. The film surveys progress in space-travel, including American firings as well as more detailed accounts of the Sputniks and Lunik probes. A highlight of the film shows the technique of Moon-photography used by Lunik III.

THOR SCHOOL CLOSES.—The Thor IRBM training school run by Douglas at Tucson closed on December 28. During the 19 months it operated 1,863 R.A.F. and U.S.A.F. officers and men received training on the Thor airframe and ground-support equipment systems.

CARRIER EARLY WARNING.—Grumman Aircraft has been awarded a $26,365,776 contract to produce additional WF-2 Tracers for the U.S. Navy. A carrier-based airborne early warning and fighter direction version of the S2F Tracker and TF-1 Trader series, the WF-2 has already completed its U.S. Fleet trials.

MORE R.C.A.F. OTTERS.—The Canadian Department of Defence Production, Ottawa, has placed an order for 27 DHC-3 Otters with de Havilland Aircraft, Canada. The new aircraft, delivery of which will start in March, 1960, will join the 39 Otters already in service with the R.C.A.F., making the Service the second largest operator of Otters in the World.

NEW SUPER BROUSSARD.—Avions Max Holste will offer a pressurized version of the Super Broussard (designated MH262) in addition to the standard MH260 described in our issue for October 30, 1959.

F-105 FEAT.—Details of the 100-km. record of 1,216 m.p.h. by Brig. Gen. J. H. Moore reveal that his F-105, which was a standard aircraft from the 334th Tactical Fighter Squadron, took off just below combat weight at 40,425 lb. gross, including 2,000 U.S. gal. of fuel. The course was flown at 38,000 ft. around 4 in. concrete marker blocks on the ground in a constant 2½-g circle of 9.9 miles radius. The course (62.14 st. miles) was completed in 183 seconds, under the impulse of the F-105's 24,500-lb. afterburning J75 turbojet.

JETSTAR HOURS.—In just over two years the two Orpheus-engined prototypes of the Lockheed JetStar have recently completed 1,000 flying hours. Now in production with four P. & W. JT-12 turbojets as an executive transport, the JetStar has also been selected by the U.S.A.F. as an advanced trainer, designated T-40. Military contracts have not yet been placed.

CASTROL FOR B.E.A.—From the Wakefield Castrol Group comes news that following Rolls-Royce and A.R.B. approval, Castrol 98—a new lubricant intended specifically for aero gas-turbine engines—has been accepted by B.E.A. and will be used on all their Viscounts and Comets as from January 1.

DRONE RECORD.—A Ryan Firebee target drone recently set a record for the type by reaching an altitude of 59,800 ft.

A.S.W. ORDER.—Grumman Aircraft has started production on additional S2F-1 Trackers under a $16,200,000 U.S. Bureau of Naval Weapons contract. The A.S.W. aircraft are for the Italian and Dutch Navies under the U.S. Mutual Assistance Program. Both countries are already operating Trackers.

U.S. NAVY UTILITY.—The new Piper Aztec twin-engine executive transport has been selected by the U.S. Navy as an economical utility aircraft. Powered by two 250-b.h.p. Lycomings, the five-passenger Aztec has a max. speed of 215 m.p.h. and a cruising speed of 205 m.p.h. Its range is in excess of 1,000 miles with a standard fuel capacity of 144 gal. Gross weight is 4,800 lb.

LEAVING FRANCE.—The U.S.A.F.'s 48th Wing of Super Sabre fighter-bombers, based at Chaumont, were to start withdrawing from France on January 6. Equipped with over 60 aircraft, the Wing is transferring to Lakenheath, Suffolk.

HSS-2 ENDURANCE.—A Sikorsky HSS-2 anti-submarine helicopter (two T58-GE-6 turbines) has completed a 50-hour endurance test in seven consecutive flying days. An article on the civil counterpart of the HSS-2 appears on pages 36-37.

BELL SALES.—During 1959 the Bell Helicopter Corporation's civil sales exceeded 100 aircraft for the third consecutive year. The company produces three commercial helicopters, the 47G-2 Ranger, the 47G-3 Trooper and the 47J-2 Ranger.

SHACKLETON RECORD.—W. S. Shackleton, Ltd., recently reached the 150th type of aircraft sold since the company was founded in 1931. It was a Douglas DC-2. In most cases several aircraft of each type have been sold, although the DC-2 was a single example. Although the company sold many DC-3s in the pre-war years, it did not sell a single DC-2 at that time.

KNIGHTED—Among those honoured in the New Year Honours List was Dr. C. Raeburn, C.B.E., D.Sc., chairman of Cyprus Airways, Ltd., since March, 1955, who receives a Knighthood.

IMPROVED SONAR GEAR.—A new long-range helicopter Sonar gear is now being produced in the United States. Developed by Bendix, the new equipment, known as AN/AQS-10, has a 360° active scanning Sonar with a range in excess of 10,000 yd.

STILL TRYING.—An Indian correspondent reports that Lockheed has renewed its offer to the Indian Government to set up a factory in India for the production of a Dart-engined Dakota replacement. Lockheed would provide 40% of the equity capital for the project in foreign exchange.

TRANSALL AGREEMENT.—The French and Federal German Governments have now signed the agreement covering a joint construction programme for the Transall assault transport powered by two Rolls-Royce Tynes. The first prototype is now being built by Nord Aviation in France; German companies involved are Blume, Hamburger and Weser.

CARAVELLE FOR U.S.—The U.S. General Electric Company has purchased a Caravelle from Sud-Aviation, for delivery on July 14 this year. It will be fitted with CJ-805-23 turbofans, which may be offered as alternatives to the Rolls-Royce RB141 in the Caravelle VII.

INDONESIAN A.F. TRAINING.—The agreement between the Indonesian and Indian Air Forces on training and co-operation has been extended. Since 1956, a large number of Indonesian A.F. personnel have been trained in India.

SAFETY COMMITTEE.—The Transport Flight Safety Committee, the formation of which was announced on July 29, is now in regular session. Its work is that of considering problems of flight safety organization, agreeing on uniform systems for the collection, analysis and exchange of information, and of advising as necessary. The membership consists of the two airline Corporations, BIATA, the A.R.B., the Air Ministry, R.A.F. Transport Command and the Ministry of Aviation. The chair is being taken in rotation by airline representatives.

Commercial Aviation Affairs

NEW SERVICES. — New normal scheduled services approved for operation by the M.o.A. include Ipswich-Southend-Ostend, by Channel Airways for seven years from April 1, and Luton (optional) - Derby - Dublin by Derby Aviation from December 20, 1959, to April 30, 1966.

AUSTRALIAN CHARTERS.—Minimum charter rates for group travel into and out of Australia have been set by the Government at 30% below the existing tourist class fares. Only airlines operating passenger services in the countries concerned will be allowed to make charter flights.

T.C.A. RECORD. — During 1959, T.C.A. carried more than 3,100,000 passengers. Capacity seat-miles produced increased by 17.5%, but passenger seat-miles flown went up by only 12.5%, causing passenger load factor to drop from 70% to 66%. Freight increased by 15% and mail by 3%.

ARAB - ARGENTINE LINK. — An agreement has been signed between Aerolineas Argentinas and Misrair providing a connection at Rome between the services from South America and Middle East respectively.

SILVER CITY PLANS.—On April 1, Silver City will move the English terminal of its air ferry to Ostend from Lydd to Manston, cutting 10 minutes off the flying time. Vehicle fares to Ostend will be cut by between 10s. and £3 10s. from June 16, and passenger fares by 6s. on April 1. Off-season fares to Deauville will apply two weeks longer than usual, until mid-June, and will apply to routes to Calais and Ostend for the first time. Flight frequencies are to be increased by 50 to a maximum of 300 a day across the Channel next summer.

SABENA SERVICES.—Sabena's first Boeing 707 arrived in Brussels on December 21, and will inaugurate a weekly jet service to Leopoldville on January 19. The twice-weekly 707 service to New York will begin on January 25, and a weekly service to Johannesburg on January 27. Frequency of all services will be increased in April.

PAN AMERICAN CHANGE.—Because of the concentration of turbo-jet aircraft overhaul at Idlewild, Pan American is to merge its Pacific-Alaska and Atlantic Divisions into one—the Overseas Division. The Latin American Division will continue and the Miami overhaul base will in future concentrate on piston-engined equipment.

AIR FRANCE FLEETS.—First of the 17 Boeing 707s ordered by Air France arrived in Paris during November and was followed by the second in the first week of December and the third later this month. First Paris-New York service is scheduled for the end of January. Two Caravelles delivered in November brought the Air France fleet to eight out of 24.

AVON OVERHAULS.—B.O.A.C. has completed its first Avon overhaul and test run at its Treforest engine overhaul base. This was a study exercise in the training factory, to establish procedures for the overhauls in the main factory which started last month. Conways from the B.O.A.C. 707s will be overhauled at Treforest starting in 1961.

IRISH COACH-AIR DROPPED.—Aer Lingus plans for a coach-air service between London, the Midlands and the North of England, and Dublin, using an air link from Valley and Dublin, have been cancelled because Air Ministry permission for the use of Valley, Anglesey, could not be obtained.

CARAVELLE SERVICE. — Air Algerie plans to inaugurate Caravelle service between Paris and Algiers on January 12.

AIRLINE CATERING.—During this week and next (January 5-16) B.E.A. is staging a catering exhibition to show the travelling public how airline meals are selected, prepared and served. The display is at Dorland House, Lower Regent Street, London, S.W.1.

LANDING INCIDENTS.—A B.E.A. Viscount 802 overshot the runway while landing at Edinburgh on December 29, with 63 occupants. A B.O.A.C. Comet 4 was damaged when the undercarriage folded during the landing run at Rome on December 23. There were no casualties in either case.

News About People

MASTER PILOTS.—GAPAN has awarded master pilot certificates to Capt. James Monro, F.R.Met.S., assistant flight manager of the B.E.A. Viscount 802 fleet, and to Mr. Alan Smith, an instructor with Airways Aero Associations since 1956.

AMERICAN TOUR.—The Secretary of State for Air, Mr. George Ward, is at present visiting the United States, Canada and Mexico. Making a tour of U.S.A.F. establishments at the invitation of the U.S. Secretary of the Air Force, Mr. Ward will also visit the R.C.A.F. at Montreal and attend the 50th Anniversary of Mexican Flight celebrations in Mexico City on January 13. Travelling by a Transport Command Comet, he left the U.K. on January 4 and is due back on January 18. Accompanying Mr. Ward on the tour is Maj.-Gen. E. Moore, commander of the U.S. Third Air Force, and Sqn. Ldr. H. T. Murley, his personal air secretary.

INDIAN DARTS.—Rolls-Royce Darts are to be built under licence in India for the Avro 748 transports which will also be licence-built there. Here Mrs. V. L. Pandit, the Indian High Commissioner in London, signs the agreement on behalf of her country with Air Marshal Sir Colin Weedon of Rolls-Royce.

COMMISSION PRESIDENT.—H. S. Marzusch, of Germany, has been appointed president of the ICAO Air Navigation Commission in succession to H. T. Mölgaard, of Denmark. The commission consists of 14 members and is responsible for the Organization's work on air navigation planning.

ICAO APPOINTMENT.—Mr. J. R. K. Main, director of civil aviation in Canada's Department of Transport, has been appointed senior Canadian representative on the ICAO Council. He succeeds Mr. J. R. Belcher.

SELLING THE 748.—On January 26, Prince Emanuel Galitzine, Avro's sales manager, leaves London for an extended tour of the Far East; he will be visiting Hong Kong, Japan, the Philippines, Viet Nam, Malaya, Indonesia, Thailand and Burma—to discuss the Avro 748 with airlines and Air Forces. On January 7 Mr. Cooper-Slipper, a senior member of the Avro sales staff, and Mr. K. Edgerton, chief performance engineer, set off on a similar 748 "sales tour" in Africa; countries to be visited are Ghana, Nigeria, Belgian Congo, Mozambique, Union of South Africa, Rhodesia, Kenya, Ethiopia and the Sudan.

Book Reviews

BRITISH CIVIL AIRCRAFT, 1919-59. Volume 1. By A. J. Jackson. 576 pp. Illustrated. Putnam and Co., Ltd. Price 63s.

IN the latest volume in Putnam's series describing British aeroplanes, A. J. Jackson has done for the civil aircraft enthusiast what Owen Thetford has already done for those interested in military types. "Jack" Jackson in fact will need little introduction to most likely purchasers of this book and his name on the cover will be sufficient recommendation. He has been a constant and devoted recorder of the contemporary civil flying scene since its early beginnings in this country and with his meticulous attention to detail and his ability to present information in a readable style, he is a natural author for this important documentary volume.

The material is presented in a similar fashion to that in the earlier "Aircraft of the Royal Air Force" and "British Naval Aircraft." Each of the most important types of aircraft is illustrated by photograph and 3-view drawing, and the excellent descriptive text is supplemented by basic weight, dimensional and performance data. Appendices cover the lesser types more briefly. The text will provide many hours of happy browsing, especially for the reader who has his own memories of sporting flying before the Second World War.

The present volume deals with the products of manufacturers from A.B.C. to Dudley Watt (the latter's inclusion under "D" rather than "W" is a little hard to understand); a second volume will cover the remainder. One criticism to which the book is open is that the title is a little misleading, for the scope of the contents is not just British civil aircraft, but aircraft which have been allocated British civil registration marks since May, 1919. Thus, a good deal of space is given to foreign aeroplanes in this category, whilst one or two British ventures (the Planet Satellite comes to mind) which were never registered will not qualify for inclusion.

Since the civil register is the basis of the book, an attempt has been made in most cases to list all the registrations of each type. Probably to save space, these lists are not complete for some of the most-produced types, such as the Tiger Moth and the Dakota, although this is not made clear in the appropriate appendix.

One other small criticism is that the C.W. Cygnet really deserves a place in this volume in its own right, although it will no doubt be described under the heading of G.A.L. Cygnet in the second volume. But it is churlish to criticize such small points when we have been given so much.—F.G.S.

ABC BRITISH AIRPORTS. By John W. R. Taylor. 40 pp. Illustrated. 7 in. by 9¼ in. Ian Allan, Ltd. Price 2s. 6d.

THIS is by way of being a supplement to "ABC London Airport" in that it describes, illustrates and gives the essential historical background for all the British airports and landing grounds listed by the Ministry of Aviation in its traffic-results bulletins. There are 41 of them, including the now-defunct Croydon; each one (except Croydon) is illustrated by means of a runway or other appropriate plan and many by photographs.

The surprising thing is that such a comparatively large number of these aerodromes were in regular use in the early 1930s, though the sites, in some cases, have been slightly modified. Of the total about 22 were in existence by 1935 and 32 by 1939. It is interesting to be reminded, in the historical summaries, of some of the earlier efforts to lay down and maintain aerodromes and of how these aerodromes sometimes proved to be too small and inextensible, or too hampered by city extensions. Manchester's first municipal airport, for instance, was laid down at Wythenshawe (licensed in 1929); Barton was opened in 1940 and Ringway in 1938.—H.A.T.

FLUID DYNAMIC DRAG. By Dr. Ing. S. F. Hoerner. 400 pp. Published by the author. Price $14.50.

SEVEN years ago Dr. Hoerner published the first edition of this unique book under the title "Aerodynamic Drag." The new edition is entitled "Fluid Dynamic Drag" because it now includes not only air but water.

This book is much more than a mere second edition of the old because it is completely rewritten. It is much larger, there being 400 pages as against 250 pages and, the page being almost twice the size of the original, there is approximately 2½ times the material that there was in the first edition.

The new edition is properly printed on good-quality paper. It has a much wider coverage, including windage on structures; hydrodynamic drag, including ordinary ships, sailing ships and hydrofoils; and a chapter on transonic drag.

The book is better written than the first edition and it is better arranged. It is an extraordinary mine of information, both ancient and modern. Every bit of information is referenced and the references are given adjacent to the figures or the remarks, so that it is extremely easy to follow through if desired.

Hoerner's background of interest in drag extends over many years. The reviewer met him first in connection with the translation of one of his papers almost 25 years ago, and Dr. Hoerner has been obsessed with the problem of drag ever since. In fact, it would be impossible for anybody not obsessed with the subject to have produced this extremely thorough volume.

In spite of the book being an extremely detailed and careful labour, it is still a personal book and individualistic in many respects. Thus, in spite of the enormous concentration of what would be useful data, the author also takes the trouble to analyse the drag of the first Wright brothers' biplane and Malcolm Campbell's "Bluebird" racing car.

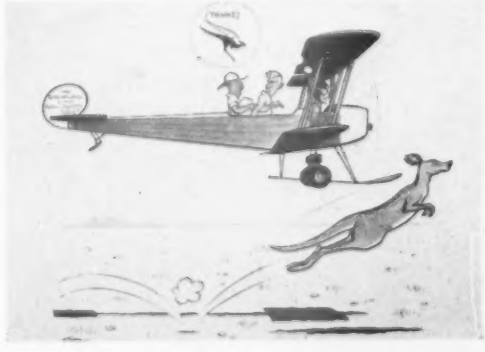
No book of this size and extent could avoid small errors, but the only one noticed by this reviewer is that on page 14—10, which depicts the Comet 4; the author refers to it as a "modern turbo-propeller airliner," which I am sure nobody would ever believe.

"Fluid Dynamic Drag" can be obtained only through the author, whose address is: 148 Busteed Drive, Midland Park, New Jersey, U.S.A. It can only be bought with U.S. dollars, that is, $15.50 invoice to be paid within 30 days, or $14.50 against a dollar cheque or money order in advance. United Kingdom readers wishing to buy the book can obtain a draft in dollars payable in the U.S.A. in favour of the author on showing a copy of this review to the bank.—B.S.S.

AIRCRAFT ANNUAL, 1960. Edited by John W. R. Taylor. 96 pp.; 7½ in. by 9¾ in. Illustrated. Published by Ian Allan, Ltd. Price 10s. 6d.

THIS annual volume from a well-known author/publisher combination is Taylor-made for the aeronautically minded with Christmas Book Tokens to spend. Its 15 chapters have been skilfully selected to provide something for all interests, from the ultra-light "do-it-yourselfers" to embryo space travellers. Progress in all spheres is expertly reviewed, with a leavening of off-beat stories about, for example, filming air epics and agricultural flying in New Zealand.

A nostalgic note is struck in "Farewell to Croydon," whilst the most avid of collectors cannot fail to be satisfied with a wealth of unpublished photographs from the two World Wars. Colour plates, included for the first time this year, make the Annual better value than ever. Outlay of a modest half-guinea will give many golden hours of reading.—F.G.S.



Oddentification.—Qantas Empire Airways are currently displaying in their Piccadilly office window fourteen Wren caricatures of aircraft types they have used since they were founded 40 years ago. The drawing shown here depicts Wren's idea of how Sir Hudson Fysh, Q.E.A.'s first pilot, founder and now chairman, got the idea for their well-known "Flying Kangaroo" trade-mark. In connection with the 25th anniversary of Qantas' association with B.O.A.C., the display draws attention to the exhibition within of drawings and paintings by Juliet Pannett and photographs by Tom Hustler of people and places they saw during their recent round-the-World flight by Qantas 707.

Personal Flying

Despite the outrageously high import duty on light aircraft, amounting in effect to about 20% of the gross f.a.f. price, the relaxation of licence restrictions by the Board of Trade last year has given something of a new look to the British civil register. Mainly involving dollar imports, the concessions have naturally resulted in the arrival of a growing number of impressive American light aeroplanes. Pipers so far lead the field; there are now six Apaches, six Tri-Pacers and six Super Cubs on the register, plus a single example of the sleek Comanche. We may expect to see an Aztec in the fairly near future, together with a Pawnee agricultural type.

Photograph copyright "The Aeroplane and Astronautics"

As recorded above, Piper lead the field of American light aeroplanes on the British register. This Super Cub, one of six in this country, belongs to Farmair Ltd., of Kidlington.

Cessnas are represented by four 310 executive twins, plus single models of the 170B and the 172. A Cessna 210, with the retractable tricycle undercarriage, should soon join them. Beech have added a Bonanza and a twin-engined Travel-Air in the past year, and there are also single examples of the Mooney Mk. 20A and the Helio Courier.

Continental types have been less affected by the changes in import restrictions but, from Czechoslovakia, three Meta-Sokols have joined the Super Aero. The Italians have sent us, so far, two Piaggio P.166s and two F.8L Falcos.

* * *

● Despite fog and rain, the following members of the Surrey and Kent Flying Club managed to solo during November: Messrs. S. P. Smith, F. R. Mitchell, D. R. Murphy and Dr. A. Joffe. A new series of lectures for pupil pilots started on December 19, and is continuing on Saturdays and Sundays until February 14. It is available to all members, with or without a licence.

● As at Exeter, the flying rates of the Plymouth Aero Club have been increased to £3 12s. 6d. an hour, dual or solo, on Tiger Moths and Austers. A first solo was made by P. M. R. Taylor.

Gliding Notes

by Dr. A. E. Slater

AN article in the London Gliding Club Gazette, strangely entitled "A Rare Phenomena," is not about several phenomena but only deals with one phenomenon, though a rather remarkable one—an upcurrent in clear air which rose higher than the top of an adjacent cloud.

Colin Richardson was on the way south-westwards from Dunstable when, between Honiton and the south coast, he entered a "nondescript" cloud street. It grew vigorously while he was inside it, and lifted him up at a great rate until, at 10,000 ft., the air became rough; so he straightened up and emerged from the cloud at just under 11,000 ft.

Then he turned back in the hope of getting further lift within the cloud up to Gold "C" height, but was surprised to see that the cloud top was an isolated peak hardly higher than he was. A further surprise was the presence of a weak upcurrent in the clear air outside it, and as Richardson circled up slowly in this clear air, he was surprised yet again to see the cloud top sink down until it was quite 1,000 ft. below him.

Richardson suggests that the cloud had so much upward momentum as to shoot beyond its equilibrium point into an inversion where the surrounding air was colder than itself, so it had to sink down again. Then, to take the place of the sinking cloud, air had to rush in, not only sideways, but upwards from below.

This still leaves a mystery why the outside air should continue to rise when 1,000 ft. above the cloud which it had come up to replace. However, the cloud must have pulled down some of the air above it, so that the total volume of descending air reached higher than the top of the cloud.

The idea that a rising cloud or thermal can shoot up well beyond its equilibrium point is rarely considered in discussions on the mechanism of thermals. Yet the late Dr. Rossby believed that the violently rising cu-nims in tropical regions overshoot their theoretical ceiling by several miles, and that this is the main reason why the stratosphere is so much higher over the Equator than over the Poles.

For some queer reason he published his thesis in an American agricultural yearbook, so hardly any meteorologist seems to have heard of it. I only discovered its existence in a list of references at the end of an article by someone else on the weather of Mars.

* * *

AT Lasham, before the Christmas party began, designs were being worked out for a standard instrument panel for all club machines, though the Olympia panel had to be somewhat different from the others because of its shape. The most important proviso was to get the variometer as near the top as possible, just to right of centre, so that the pilot need scarcely move his eyes to look out for other machines in the same thermal when circling.

From this point of view (literally), the position is only inferior to that of the first British variometer invented by David Dent in 1933, which stuck up vertically from the top of the fuselage, not much more than a foot in front of the pilot's nose. But there were no instrument panels in those days; as soon as they arrived, all instruments were taken out of the air stream except the pitot tubes, and even they have mostly gone indoors now.

At the party, Jill Walker's two trophies, kindly provided out of her winnings in a football pool, were presented to John Corbett and George Burton. The idea of these trophies is to encourage Lasham members to do as much cross-country flying as they can during each year, one trophy being for flights in (or mostly in) club machines, and the other for flights (mostly) in privately owned machines. Certain tasks are set at the beginning of the soaring season, with marks allotted to each; candidates are encouraged to do as many different kinds of task as possible, but can also do any task any number of times.

Graphs on the notice-board, giving the progress of cross-country mileage from Lasham in the course of each year (excluding national championships) show that, up to July, 1959 was inferior to all other years except 1955; yet by December it had reached a record of about 13,500 miles, compared with 10,300 miles in 1957, the next best year. Although surface heating does not necessarily produce the greatest instability higher up, the hot July, August and early September were evidently responsible this time.

* * *

WHEN a trough passed over the Long Mynd on December 27, the first day of the Army Gliding Association's "Wave Safari," the wind veered at cloud level quite 20 minutes before it did so on the ground and began blowing up the hill instead of along it. Half a dozen machines were soon up, mostly above 1,000 ft. in the slope lift, making the best of the last hour of daylight.

Not all were from the Army; several private owners had come from Lasham, there was a party from the Avro Gliding Club at Manchester, and the Moonrakers R.A.F. Club had brought their Olympia 419 and another Olympia from Upavon. According to John Williamson, their chief instructor, the Moonrakers find that from a 1,500-ft. launch at Upavon they can reach the lift over Huish Hill, which is soarable in southerly winds. Five members have done their 5-hour durations for Silver C there since October.

The Midland Gliding Club, with four days still to go, had completed 2,354 hr. 25 min. of flying this year from 9,516 launches, of which 842 were by bungee.

Correspondence

Background to the S.E.5A . . .

IN his excellent article (December 25 last) on flying the rebuilt S.E.5A at Farnborough recently, Cdr. Hickson asks if the pilot had a greater say in design "in those days." The answer is that Maj. F. W. Gooden, chief test pilot of the Royal Aircraft Factory, was one of the three principal collaborators in the design; the others were H. P. Folland and J. Kenworthy.

Gooden sketched a new "scout" around the Hispano engine, based on the S.E.4A on which he was conducting further flight trials early in 1916. On the basis of this outline layout, Folland and Kenworthy got to work and produced the S.E.5 details complete by August of that year and the prototype flew late in December.

The basic credits are set down by Col. Mervyn O'Gorman in the appendix to the work "Sefton Brancker" and were corroborated subsequently from time to time by Gooden's fellow test pilots of that epoch, Tait-Cox and the James brothers.

Woking, Surrey. C. F. ANDREWS.

. . . and Some Reminiscences

CDR. HICKSON'S delightful appraisal of the S.E.5A (Dec. 25 last) interested me greatly as this dainty little aeroplane was a great favourite of many of us on the Palestine front in 1918.

His description has aroused many memories and the starting-up procedure particularly so, when the "aged retainer" (probably in breeches and puttees) climbs up to prime the induction manifolds followed by some frenzied twirling of the starter mag., which was undoubtedly better done by external help.

Our S.E.5As of No. 145 Squadron, however, had four-bladed props and for that reason perhaps the h.f. vibrations at low power ranges were not so noticeable—one remembers the peculiar chatter caused by backlash but never attributed anything sinister to it because the Hispano gave such magnificent performance compared to some other engines then in use.

The photograph indicates the original "tin" undercarriage fitted to D.7000. To cope with our rough Palestinian aerodromes there was a mod. which gave us stout streamlined ash struts in place of the thin oval steel tubes which made the aeroplane far safer to taxi. I think I probably finished off the last of the "tin" undercarriages on Ramleh aerodrome just turning to take off. It was a ridiculously weak undercart for an aeroplane which, as Cdr. Hickson rightly says, was prone to an "ever-increasing series of bounces" if landed badly. But the satisfaction of a good three-pointer was quite something!

Although primarily a "Scout," as we called the fighter of that day, to ours we had fitted four 20-lb. Cooper bombs under each wing and one never quite knew how many had failed to release. However this hazard was really less menacing than that Lewis gun-mounting a foot or two in front of one's forehead which was ready to act as a perfect tin-opener in the event of an even mild deceleration.

I am sure there are many "old-timers" like myself who read this article with enjoyment and nostalgia. I just wonder how many would be prepared to fly this aeroplane today. Being one of a few who still keep a current licence is there any chance, you lucky lads at Farnborough, of "having a go"? I shall taxi out ever so carefully!

Holywood, Co. Down. R. CHEVALLIER PRESTON.

Books to Read

I FOUND John Fricker's article on "Aviation's Ten Best Books" (THE AEROPLANE AND ASTRONAUTICS, December 25) so interesting that I am inspired to include some more for John's and any other reader's benefit. The finest book ever written (in my opinion) is Maurice Baring's classic "R.F.C. H.Q. 1914-18"—read it, and you will see why; "Flying Minnows," by Roger Vee, is the story of a Bristol Fighter Squadron—an unusual story; "An Airman Remembers," by Hans Schröder; and "Into the Blue," by Norman Macmillan—who, I am thankful to say, is still writing as strong as ever.

Bert Hall's "One Man's War," the story of the Lafayette Escadrille, is another excellent book and "Flight into Hell," by Edwin C. Parsons, is another written by an American pilot. I would like to include "War Flying in Macedonia," by Haupt Heydedmarck, and "Wings of War," written and illustrated by Rudolph Stark. All these are 1914-18 War experiences.

With regards to the Hitler War, Clostermann's counterpart in the Far East is undoubtedly Saburo Sakai who wrote "Samurai." I hope there are more to come.

Birmingham, 14. MAURICE AUSTIN.

Facts and Photographs Wanted

I HAVE been asked to prepare two short histories: one of Royal Air Force Station Ternhill and the other of No. 6 Flying Training School.

In this connection I am anxious to make contact with those of your readers who may be able to contribute items or photographs of historical interest.

Any publicity which you can give in your columns to this project would be greatly appreciated.

No. 6 F.T.S., R.A.F. Ternhill. SQN. LDR. W. H. CADAMY, R.A.F.

Roundabout

Coming to a pretty pass. . . . Among the statements of 1959 which deserve recording is Lufthansa's revelation of the Current State of the Art—"Manchester," they said, "has been taken out of the winter schedules because we shall be using longer-range Super Constellation airliners. Now we do not have to stop for refuelling, it is not worth while landing there for the sole purpose of picking up passengers." After all, passengers do rather mess up those elegant cabins, then there's all that infernal *ticketing* and taking their *money*. Roll on the nuclear-powered airliner, then landings and passengers will be a thing of the past.

*

"But, sir, that *is* how a rocket works—it doesn't."

*

". . . ten, noine, eight, siven, six, foive. . . ." A 1960 project which I hope to hear more of is the plan of students of Trinity College, Dublin, to fire that city's 135-ft. high Nelson's Pillar at the Moon. Writing in the college magazine, "Taurus" explains that it will be a 3-stage job and that by landing the top portion in the Sea of Serenity next St. Patrick's Day, the Irish will be able to out-boast their lesser competitors with "Nelson Lands on the Moon." From a private source I understand that a revolutionary fuel will be used—peat.

Another bit of satelliteweight humour concerns one of the American devices which, I hear, has become the first space nuisance. Having served its useful purpose it is still orbiting, sending out the same old stuff all the time. Perhaps the X-15 could have a go at shooting it down. Before the Russians do.

*

Business Booming. Everybody's getting in the act. Before Christmas, Dads were being urged by Raleigh's to buy their sons a "supersonic" bicycle. Bell, lamps and Machmeter extra.

*

"Dear Diary. . . ." Useful thing, THE AEROPLANE Diary. Among the things I've learned from it is that there's an aeroplane, looking remarkably like Edgar Percival's E.P.9, called the Lancashire Prospector. Sounds more like a pub. The diary also has a foreign languages section, invaluable if, for instance, you found yourself in dire need of a "Blade" (prop.? turbine? compressor? sword?). In Portugal you'd just go into the nearest blade shop and ask for a "Pa"—in Germany you need another four syllables—"Luftschraubenflugel." Have you ever actually *read* your diary?

by Lorenz

NOTES AND EVENTS

ONE FOR THE ROAD.—Shell Mex and B.P.'s new Severn Super Fueller, which has a 10,000-gallon capacity and can deliver aviation fuel at 750 gallons per min., fuels a Comet 4 in the maintenance area of London Airport.

MACHRIHANISH CONTRACT.—Tarmac Civil Engineering, Ltd., of London and Wolverhampton, has been awarded the R.N. Air Station Machrihanish contract for the extension of the runway and the provision of new taxiways, tracks, hardstandings and the construction of a 3-mile tow-way from Machrihanish to Campbeltown, Kintyre, Argyllshire. This is a NATO project, executed under Admiralty authority. The cost will be about £1¼ million.

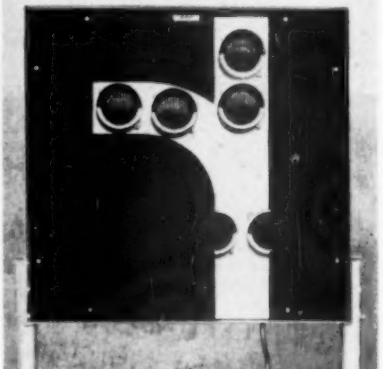
WORK TRANSFERRED.—As from this month, the manufacture and marketing in the U.K. of Surform and Surcut surfacing and cutting tools will be transferred from Simmonds Aerocessories, Ltd., to Firth Cleveland Tools, Ltd. Both companies are members of the Firth Cleveland Group. The home sales office will continue to be at the group headquarters, Stornoway House, Cleveland Row, London, S.W.1.

PLESSEY ON SHOW.—Several results of the technical advances made by the Plessey Co., Ltd., in 1959 can be seen on stand No. 28 at the 1960 Physical Society Exhibition to be held at the Agricultural Hall, Westminster, from January 18 to 21. A wide selection of the latest developments in electrical, electronic, electro-magnetic and nucleonic engineering will be on show, some of the Plessey exhibits being either prototypes or research models and therefore not yet commercially available.

RETIREMENT.—Mr. J. J. Scholes, the manager of National Benzole's Lancashire division which has its headquarters at Peter House, Manchester, retired on December 31. He has been succeeded by Mr. T. F. Macfarlane, the company's retail marketing manager. An R.F.C. pilot in the First World War, Mr. Scholes is well known in aviation circles. He was National Benzole's aviation manager from 1930 to 1939 and was one of the first flying salesmen in the country.

DUNLOP CHANGES.—A reorganization has taken place in the Dunlop public relations department headed by Mr. J. Campbell Fraser. Mr. A. J. H. Woodgates becomes responsible for Press relations and Mr. J. Cullis, Press officer for the past two years, takes over control of institutional advertising and film production.

SHORT TRADEMARK.—The name Simlac has been adopted by Short Brothers and Harland, Ltd., as the trademark of the new range of general-purpose computers now being developed by the company. The standard Simlac is a 112-amplifier linear computer, but the basic design is such that the particular requirements of individual customers can be met, by plugging the specified components into the standard Post Office type racks.



PILOT DIRECTING.—This ZA. 610 taxi route indicator manufactured by the General Electric Co., Ltd., uses lights to show pilots which route to take when taxi-ing up to a junction.

SIGNAL GENERATOR.—Taylor Electrical Instruments, Ltd., Slough, announce that they will be releasing on January 16 a new AM/FM signal generator. The equipment, known as the 61A, is designed mainly for servicing AM and FM receivers and the intercarrier IF stages of television receivers.

Aviation Calendar

January 9. — British Interplanetary Society Film Show, in the Lecture Theatre, Science Museum, Exhibition Road, **London,** S.W.7, at 19.00 hrs.

January 12.—R.Ae.S. 94th Anniversary Luncheon at the Dorchester Hotel, Park Lane, **London,** W.1.

January 12.—R.Ae.S. Gloucester Branch lecture, "Proteus Icing Experience," by G. F. Pitts, in the Wheatstone Hall, Brunswick Road, **Gloucester,** at 19.30 hrs.

January 12.—R.Ae.S. Bristol Branch lecture, "Discoveries from the Study of Satellite Orbits," by D. G. King-Hele, at Filton House, **Bristol,** at 18.00 hrs.

January 12.—R.Ae.S. Chester Branch lecture, "Parachutes and Parachute Design," by S. B. Jackson, in the Lecture Theatre, Grosvenor Museum, **Chester,** at 19.30 hrs.

January 13.—R.Ae.S. Graduates' and Students' Section lecture, "Aviation Medicine in the Space Age," by Wg. Cdr. F. Latham, in the Library, 4 Hamilton Place, **London,** W.1, at 19.30 hrs.

January 14.—R.Ae.S. Astronautics and Guided Flight Section lecture, "Future of Automatic Control on Fixed Wing Aircraft," by Prof. G. A. Whitfield, at the Institution of Mechanical Engineers, 1 Birdcage Walk, **London,** S.W.1, at 18.00 hrs.

January 14.—R.Ae.S. Graduates' and Students' Section Glasgow Branch lecturettes by Section members, at Scottish Aviation, Ltd., **Prestwick,** at 19.30 hrs.

January 15.—Institute of Navigation lecture, "Heading Definition in Commercial Aircraft," by J. F. Green and A. P. Glenny, at the Royal Geographical Society, 1 Kensington Gore, **London,** S.W.7, at 17.15 hrs.

January 15. — R.Ae.S. Agricultural Aviation Group lecture, "Biological Factors in Agricultural Aviation," by C. V. Dadd, in the Library, 4 Hamilton Place, **London,** W.1, at 19.00 hrs.

January 15.—R.Ae.S. Birmingham and Wolverhampton Branch lecture, "Aircraft Heat Exchangers," by Dr. W. Bergwerk, at Marston Excelsior, Ltd., **Wolverhampton,** 19.30 hrs.

Company Notices

NEW COMPANIES

Gordon Seating Co., Ltd. (644,757).—Private co. Reg. December 17. Cap. £1,500 in £1 shs. Objects: To carry on the business of manufacturers of and dealers in automobile and aircraft seating, etc. Directors are: Frank Jackson, 360 Longbridge Lane, Birmingham, 31; Douglas A. Kennelly, 74 Bloomfield Road, Birmingham, 13; Joan Ward, 21 Serpentine Road, Birmingham, 29. Sec.: Joan Ward. Reg. office: 21 Serpentine Road, Birmingham, 29.

Crotall Engineering Co., Ltd. (644,674).—Private co. Reg. December 16. Cap. £5,000 in £1 shs. Objects: To acquire the business carried on as "Crotall Light Engineering Company" and to carry on the business of consultants and designers in connection with the trade or business of aircraft engineers, aircraft test pilots, motor, marine, electrical, precision and general engineers, etc. Directors are: Edward J. Saunderson, Vinnicks, Highclere, Hants; William G. Bishop, Starwater, Washwater near Newbury; Thomas W. Cronin, 50 Chandos Road, Newbury. Sec.: J. M. Freeman. Sol.: Charles Lucas and Marshall, Newbury. Reg. office: White Hart House, Market Place, Newbury, Berks.

Personal Notices

ENGAGEMENT

Dangerfield-Pontifex. — The engagement is announced between Richard, son of Mr. and Mrs. Roland Dangerfield, of Hoe Farm, Peaslake, Surrey, and Jillian, daughter of Mr. and Mrs. Geoffrey Pontifex, of Shere Lane Cottage, Shere, Surrey.

BIRTHS

Davies.—On December 18, at B.M.H. Taiping, to Jean (*née* Goate), wife of Flt. Lt. Brian Davies—a son.

Hamilton.—On December 19, at the B.M.H. Paris, to Primrose (*née* Craig), wife of Flt. Lt. A. G. Hamilton—a son.

Kerr.—On December 23, at R.A.F. Hospital, Akrotiri, Cyprus, to Jill (*née* Knight), wife of Flt. Lt. Michael Kerr—a son.

Salter.—On December 28, at Mount Stuart, Ilie, Fife, to Josephine (*née* Parry), wife of Sq. Ldr. I. K. Salter—a daughter.

DEATHS

Henderson.—On December 20, in hospital, Flt. Lt. Frederick George Henderson.

Inglefield.—On December 20, at R.A.F. Hospital, Uxbridge, Wg. Cdr. Lionel Coore Inglefield.

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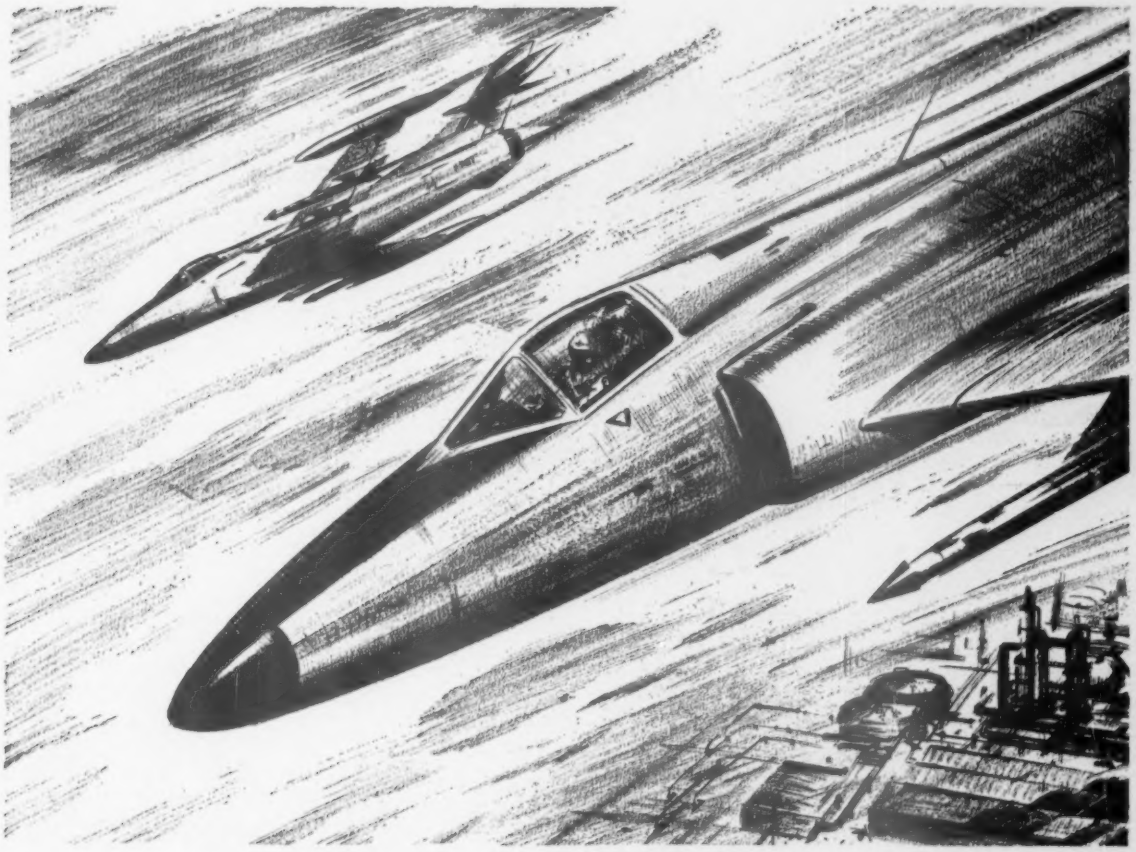

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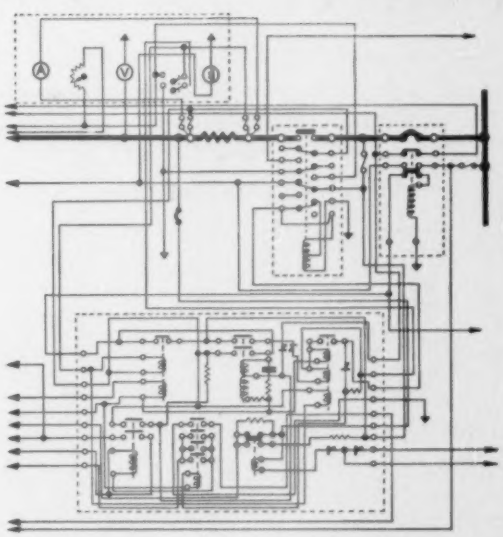

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